SCIENTIFIC AMERICAN

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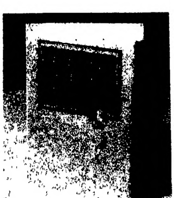

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The SCIENTIFIC AMERICAN DIGEST

SCIENTIFIC AMERICAN

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NINETY-SIXTH YEAR • ORSON D. MUNN, Editor

CONTENTS • JANUARY • 1940

THE fighting power, speed, maneuverability, and armor of modern tanks have been enormously improved over their wartime ancestors. Yet anti-tank defenses and anti-tank guns have also been improved so that a tank-corps man's job is still next door to suicide. The modernized 75mm gun discussed on page 16 will not make it less hazardous—if the tank is on the receiving end.

18988

SCIENTIFIC AMERICAN, January, 1940 Vol. No. 162, No. 1, entered at New York, N. Y., Post Office as second class matter June 28, 1879, under the act of March 3rd, 1879; additional entry at Orange, Conn. Published monthly by Munn & Company, Inc., 24 West 40th Street, New York City. Copyrighted 1939 by Munn & Company, Inc. Great Britain rights reserved. Subscription price $4.00 per year. Canada $4.50 Foreign $5.00. Manuscripts are submitted at the author's risk and cannot be returned unless accompanied by postage

50 YEARS AGO IN . . .

SCIENTIFIC AMERICAN

(Condensed From Issues of January, 1890)

SPARK PHOTOGRAPHY—"Rifle bullets are now photographed in their course by means of the electric spark The camera is taken into a dark room, which the bullet is caused to traverse As it passes the camera it is made to interrupt an electric circuit and produce a spark, which illuminates it for an instant and enables the impression to be taken. The wave of condensation in the air before the bullet and the rarefaction behind it are visible in the photograph, and can be studied by experts, thus enabling the form of ball or rifle which minimizes the resistance of the air to be selected."

TRAMWAY—"We illustrate a novelty in tramway practice, taken from the railroad operated in the beautiful town of Ontario, San Bernardino County, Cal. The railway passes through the middle of Euclid Avenue, a broad and beautiful street, bordered with orange and lemon trees The avenue is some 6½ miles in length, with

heavy grades as it approaches the hills The car is drawn up hill and over the levels by a pair of mules, but in going down grades the mules ride and the car moves by gravity, as shown in our engraving. A platform with folding sides is provided, which is supported near one end upon a pair of wheels . When the mules are the tractive power the sides of the platform are folded down and the whole rolls back under the bottom of the car, where it remains and is drawn along the track with the car"

SAFETY—"In his recent message to Congress, President Harrison laid much stress on the need for adopting means for insuring the safety of railroad employes. An annual death list from accidents in service of over 2,000 railroad employes, with ten times the number injured, was cited by him as illustrating the urgent nature of the case. He suggested congressional action, requiring uniformity in the construction of cars used in interstate commerce, and the use of improved safety appliances upon such cars"

SHIPS—"Shipbuilding on the Maine coast was more active during the past year than it has been since the palmy days before the war, when the fleet had the pick of the carrying trade Yards which for years scarcely paid expenses are doing a thriving business, and others for long deserted echo with strokes of adz and caulking mallet."

LIGHTING—"The controversy now in progress between the promoters of the rival systems of incandescent lighting, though some will think of doubtful expediency, so far as the companies are concerned, admirably serves to acquaint a public now grown timorous, with the detail of operation and with the nature of the precautions which, if employed, would render both systems entirely safe, at least to the user."

PIPE-LINE—"The oil pipe line which was recently constructed from Cygnet, Wood County, Ohio, to Cleveland, is one of the best in the country, yet it is necessary to watch it vigilantly to prevent any leaks Track walkers pass over every mile of the line each day, about 15 miles being assigned to each man. Every walker is a telegraph operator and is supplied with a pocket instrument Should he discover a leak in the line, he immediately telegraphs the division superintendent At stated intervals along the telegraph lines wires run down the poles into locked boxes, the key of which is carried by the walker. Opening the box, he attaches his instrument and wires a report to headquarters"

FORTH BRIDGE—"The practical completion of the great bridge over the Firth of Forth was effected on Thursday, November 7, when the interesting operation of joining in the center the girder which forms the connecting link between the Inchgarvie and North Queens Ferry cantilevers was successfully accomplished"

HAND MINING—"When two men can take out $100,000 in less than a year from a quartz mine, they are doing a pretty good business Yet this is what two young men, Messrs. Grant and Appel, have done in the Chipps Flat pocket mine, between Moore's Flat Nevada County, and Allegheny, Sierra County. And they have no mill, either, simply pounding the rich rock up in a mortar by hand"

WAR SHIP—"The new British war ship *Blake*, lately launched, it is calculated, will be the fastest war vessel afloat, and, for her class, the strongest fighting ship Displacement, 9,000 tons; length, 375 feet, beam, 65 feet, draught, 25 feet 9 inches, twin screws, 20,000 horse power, maximum speed, 22 knots, or over 25 miles per hour As a ram, at this high velocity and her great weight of 9,000 tons, it is doubtful if any vessel could withstand the shock The Blake is constructed of steel throughout, has six-inch armored turtle-back steel deck, covering the magazines, torpedo rooms, engines, and boilers. Fuel space, 1,500 tons She is to carry two 9 inch 22 ton breech-loaders and ten 45 pounder quick-firing guns, each capable of firing 12 times per minute."

MUSCLE SHOALS—"The obstructions known as the Muscle Shoals, in the Tennessee River, which cover about 23 miles out of the 453 between Chattanooga and Paducah, at the mouth, are at length overcome by means of locks and dams built by the government, and the river is now open so that boats loaded at New Orleans can at all times proceed to Chattanooga and most of the time to Knoxville The distance from Chattanooga to New Orleans is 1,601 miles"

AND NOW FOR THE FUTURE

¶**Nylon, Newest Contribution of Chemistry to Industry, and What It Promises for the Future.**

¶**Atom Smashers — What They Are, What They Do, and How They Do It. By Douglas W. F. Mayer.**

¶**Application of Engineering Principles to Dentistry Makes for Better Dentures. By A. W. Jessup.**

¶**A Four-Lane Highway Bridge that, for a Mile of its Length, Floats on the Surface of the Water. By Charles F. A. Mann.**

Personalities in Science

EDGAR D. TILLYER

EVERY person who wears glasses owes to Dr. Edgar D. Tillyer, internationally known lens authority, a debt of gratitude so great that mere words cannot express it. His brilliantly creative mind has contributed more than a hundred important developments in the field of optical science.

Intricate scientific problems are always tempting to Dr Tillyer. A small man with a large domed head crowned by a mop of gray hair, he'll seize a pad of paper and cover it with an astonishing array of mathematical computations. Out of these complex calculations will come a new lens system, a new eye-testing instrument, a new lens-measuring device or, just for relaxation, new developments in the motion picture or radio fields

Dr. Tillyer was born at Dover, New Jersey, December 7, 1881 A graduate of Rutgers University, his first position was that of Computer with the Nautical Almanac Office at Washington, D. C In 1907, he became an Astronomical Observer in the Naval Observatory at Washington. Four years later, he entered the Bureau of Standards in the same city. Then, in 1916, he accepted the invitation of the American Optical Company, Southbridge, Massachusetts, to direct its Research Laboratories.

While at the Naval Observatory, Dr Tillyer designed and built the clock vault temperature control and also designed a pair of astronomical photographic lenses for the observatory.

As a member of the Bureau of Standards, he performed a notable service: He revised the old types of submarine periscopes and wrote the then standard periscope specifications of the United States Navy. He also determined and wrote gunsight specifications for the Navy.

During the World War, Dr. Tillyer did splendid work for the United States Government. One of his conspicuous achievements was re-designing a telescopic sight for the French 37-millimeter tank-repelling gun. The barium crown glass used in the former gunsight was not obtainable here in sufficient quantities and several of the largest lens manufacturers declared that this gunsight had to be made of barium glass But Dr. Tillyer re-designed the lens system, using plain optical glass Trials showed that the telescopic sight using ordinary spectacle glass was more efficient than the French barium glass sight

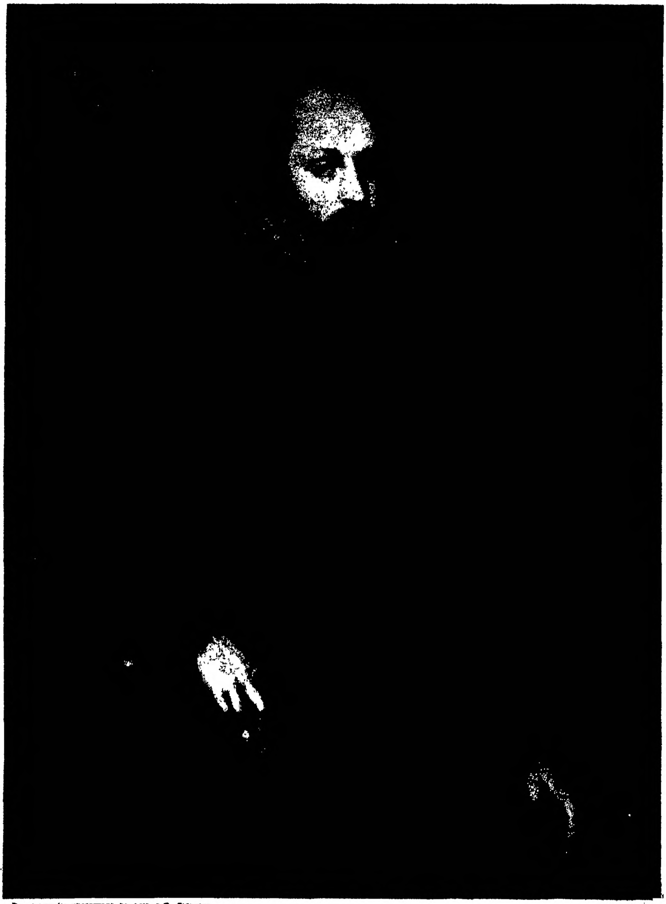
Perhaps the best known of the scientist's developments is the Tillyer lens, a highly significant development which took years to perfect

Only a few weeks ago Dr. Tillyer announced the latest development to come out of the American Optical Company Research Laboratories—the successful grinding of Polaroid sun glasses to prescription after five years of intensive experimentation.

In the motion-picture projection field, Dr. Tillyer is the inventor of the automatic heat screen—a lens in the projector system which will transmit the light rays and retard the heat rays, thereby preventing the film from burning when the machine is stopped. In the radio field, among other things, he devised one of the widely used methods of cutting quartz crystals for radio frequency control.

Dr. Tillyer's supreme delight is the development of new types of glass. At the present time, he is working on radically different glass compositions. Tantalizingly, with a twinkle in his eyes, he refuses to talk about these new glasses, but does admit that one group has the property of not dissolving in hydrofluoric acid which dissolves all ordinary glasses

Seemingly, Dr. Tillyer lives for science alone, but this is far from the truth Genial, possessed of an excellent fund of stories, his tastes are catholic and his hobbies many. Intensely interested in photography, nothing pleases him better than to project his excellent collection of colored photographs for his friends. He loves to fish and cheerfuly admits the fish generally elude him. His badminton is not what it might be, but he enjoys the game anyhow. As for bridge, rumor has it that he has developed a new system which, unfortunately, does not prove infallible. In respect to literature, he states with refreshing candor that he likes nothing better than an exciting detective yarn.



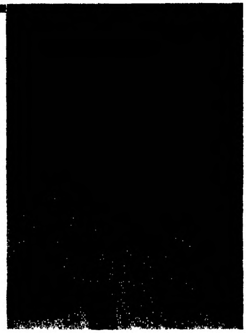
Panchromatic photograph by Arthur G. Eldredge

X RAYS REVEAL THE SECRETS BENEATH ITS PAINT

Above The famous "Ashbourne" portrait of William Shakespeare, owned by the Folger Shakespeare Library, Washington, D. C., now, for the first time, dissected with infra-red and X-ray photography. The small picture at the left is Dugdale's engraving (1656) of the skull symbol on the Stratford monument to the Bard, and is reproduced here for comparison with the skull in the "Ashbourne."

Figure 1 Left: **Edward de Vere 17th Earl of Oxford and Lord Chamberlain of England. Born April 12, 1550, died June 24, 1604 Painted in 1575 when this mysterious poet-peer was 25 years of age. From the original owned by the Duke of Portland**

Figure 2 Right **A heretofore unpublished portrait of Lord Oxford, identifiable as the work of Marcus Gheeraedts. "It has frequently been reported," says A Wivell (1827), "that Marcus Gheeraedts had painted Shakespeare, but nobody knows whence it originated" Painting owned by the Duke of St. Albans**



IDENTIFYING 'SHAKESPEARE'

Science in the Shape of Infra-red Photography and the X ray Brings to Light at Last the Real Man Beneath the Surface of a Series of Paintings of the Bard

By CHARLES WISNER BARRELL

A SENSE of mystery has always surrounded the personality of Shakespeare, the prince of dramatists, as compared with the citizen of Stratford-on-Avon who signed himself—evidently with painful difficulty—Willm Shakspere The latter left no letters, manuscripts, books or other relics of creative endeavor Both of his parents, as well as his own 26-year-old daughter, were so illiterate that they could not write their own names, as the village records testify. Will himself is stated by two 17th Century investigators to have been working as a butcher's apprentice up to the time he left his wife and three small children to seek his fortune in London There is no contemporary citation of his ever having attended school a day in his life or of having received any training whatever in any of the liberal arts with which Shakespeare, the dramatist, shows such intimate familiarity. Finally, during the heyday of the playwright's creative career, the Stratford citizen appears in the annals of his native town as malt dealer, money lender, and land speculator

While it is entirely possible that this jack-of-all-trades may have had some

***Figure 3:* Lord Oxford's head, enlarged from the Portland portrait**

***Figure 4:* Shakespeare's head. To be compared with those of Oxford**

***Figure 5.* Lord Oxford's head enlarged from the St. Albans painting**

THE accompanying article, on a subject which may at first strike the reader as literary rather than scientific, is published in Scientific American because its major premise is in the realm of science the recent findings of the X-ray and infra-red photography.

Was Shakespeare really the man of Stratford-on-Avon, or was he someone else? Why go out of the way to question the familiar belief that he was simply himself—do we not know his life? Unfortunately, we do not As George Steevens, early English Shakespearian scholar, once said: "All that is known with any degree of certainty concerning Shakespeare is, that he was born at Stratford-on-Avon, married and had children there; went to London where he commenced actor and wrote poems and plays, returned to Stratford, made his will, died and was buried."

In the perennial and at times bitter war about the identity of Shakespeare, likely now to enter a fresh phase based on the new findings of science, the editors of this magazine remain neutral—*The Editor*

business connection with the London theaters, it has been difficult for many students of his personal life to see in him the profound philosopher and cosmopolitan artist who wrote "Hamlet" and some 30 other masterpieces

As a result, fully a thousand volumes have been published in the past hundred years, vigorously disputing the claims of Willm Shakspere to the rank of Number One literary genius of the race

The main contention of these anti-Stratfordians is that "William Shakespeare" was a pen name, like "Moliere," "George Eliot" and "Mark Twain," which in this case cloaked the creative activities of a master scholar in high circles who did not wish to have his own name—or title—emblazoned to the world as that of a public dramatist It is a well-known fact that the stage was held in social disrepute in the Elizabethan age. On the statute books, "vagabonds, thieves, and players" were lumped together as undesirables Creative poets then were not by any manner of means accorded the same degree of reverence that they now command as "classics" "The Arte of English Poesie" (1589), first comprehensive analysis of the subject, makes the following significant statement " . in these days (although some learned Princes may take delight in Poets) yet universally it is not so For as well Poets as Poesie are despised, and the name become of honourable infamous subject to scorn and derision, and rather a reproach than a praise to any that useth it" This work is but one of many testifying to the low estate occupied by Elizabethan poets generally

DURING the course of the debates relating to the real personality behind the Shakespearian works, much contemporary evidence discovered in the past 20 years has led modern investigators to believe that Edward de Vere 17th Earl of Oxford really had a much more intimate connection with the immortal plays and poems than has been realized heretofore More than 30 volumes have been issued in presentation of Lord Oxford's claims

The same mysterious incongruity that surrounds the disputed personality of the dramatist also shrouds the paintings that have been known for many generations as "life portraits" of the Bard.

There are at least 12 of these, some on canvas, some painted on ancient wooden panels, which many art experts agree

Figure 6 Oxford's hand, St Albans portrait Note long thumb and wild boar device

Figure 7 Shakespeare's "Ashbourne" hand Note long thumb, signet-ring, gauntlet

are of undoubted Elizabethan or Jacobean composition Several of the pictures are inscribed with dates that fit into the Shakespearean chronology, though none of approved technical ancientry bears any discernible name or artist's mark on its surface

Until the early part of the 19th Century, six of these paintings had been held for unknown periods—evidently from the same age in which the Shakespearean plays originated—by various members of the old English aristocracy. It is significant that none of them can be shown to have had any Stratfordian ownership connections whatever. Moreover, very few of the works had until comparatively recent times ever been put up for sale or otherwise exploited publicly One of the most interesting of them, which pictures the poet richly garbed, was taken from the Tudor collection in Windsor Castle by Queen Victoria for presentation to Lord Lytton, the novelist. As a matter of fact, eight out of the 12 genuine Renaissance studies of Shakespeare, as listed by the "Encyclopaedia Brittanica," depict him wearing the unmistakable attire of a nobleman

To explain this remarkable circumstance, Stratfordian writers have conjectured that Willm Shakspere may have been painted in stage costume But this theory lacks corroboration from contemporary sources Among the six or eight authenticated portraits that exist of other prominent figures in the Shakespearean theater, such as Richard Burbage, Ben Jonson, Ned Alleyne, William Sly, and John Lowen, not one is delineated in any such fashion On the contrary Elizabethan actors and dramatists—with the one outstanding exception of Shakespeare—sat for their likenesses in sober, unobtrusive garb During the days of Good Queen Bess, as official annals state, sumptuary laws regulated the wearing apparel of the classes quite as strictly as our modern statutes regulate the use of police uniforms

So when we find a number of traditional portraits of the Bard which show him sporting the dress clothes of the Elizabethan nobility, excellent *prima facie* evidence would appear available to suggest that he may actually have been a member of the privileged class, just as the Baconians, the Oxfordians, and other heretical disbelievers in the conventional

Stratford legend have been contending, all along.

Acting on this hitherto strangely neglected hint, and having familiarized myself with much of the essential testimony in the case of disputed personalities, pictorial and otherwise, I secured permission about two years ago from the owners of some of the best-known Shakespeare paintings to investigate them with the modern scientific media of infra-red and X-ray photography

It seemed possible that underneath the outer coats of one or two of these ancient works might be concealed some key to the mystery that has puzzled so many students throughout the centuries

The paintings finally selected for dissection include the half-length panel owned by the King of Great Britain at Hampton Court Palace, the head-and-bust panel, known as the "Janssen," owned by the Folger Shakespeare Library at Washington, D C, and the three-quarter length canvas, generally called the "Ashbourne," which is also now the property of the Folger foundation

Figure 9 **Infra-red closeup, Shakespeare's head. Note raised forehead, under-surface outlines of original ruff**

In each instance, my technical associates and I have uncovered clear-cut evidence to show that details of the original portraiture have been changed and that certain areas which previously displayed symbols of personal identification have been completely painted over.

The manner in which this work of concealment and disguise was carried out, the character of the brush strokes employed, and the present condition of the surfaces of all three pictures, make it apparent that the changes were made at some remote period. It also seems evident that the hand of the same furtive craftsman was utilized throughout

Comparative research on recovered details of the original compositions and on all personal symbols of both the sitter and the artists who painted him, now for the first time brought to light, show beyond reasonable doubt that the Shakespeare who appears in these works must have been the mysterious

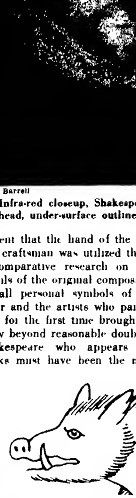


Figure 10 The wild boar device of the Earls of Oxford. From a Tudor MS published by Lord Howard de Walden Compare with Figure 12

Elizabethan court poet, Edward de Vere 17th Earl of Oxford, and not the member of the illiterate Shakspere family who was buried at Stratford-on Avon, April 25th, 1616

Before discussing in detail the evidence brought to light by study of these paintings, it is appropriate that certain background facts be given on this poetical Lord Great Chamberlain of the Shakespearean age As contrasted to Willm Shakspere the elusive business man, Edward de Vere, who "wasted his substance" and squandered his patrimony on men of letters, was intimately associated with many of the best known playwrights of the day, acted himself, patronized several companies of players, and was acclaimed by leading Elizabethan critics as the "most excellent" of all the Court poets—"the best for comedy among us" The personal drama of Lord Oxford's own life is realistically presented in a dozen or more of the Shakespeare plays, while the literary nobleman's personal letters have been found to abound in situations, points of view, and more than 150 dramatic figures of speech that reappear in the plays and poems

SHAKESPEAREAN scholars have never been able to account for the Bard's obvious knowledge of Italian and French literature in the original Shakspere of Stratford never traveled on the Continent Edward de Vere, however, not only visited France Italy, Germany and the Lowlands, he spoke, read and wrote Latin, French and Italian fluently His social position as the premier earl of his era would account for his familiarity with manners, customs and speech at Court Presented with an honorary degree at Oxford, he was told by the orator of the day—who later figured as an early commentator on Shakespeare's works—"*thy countenance shakes a spear.*" A member of Gray's Inn Society of legal lights, he had an intimate knowledge of law—reflected in all the plays Largely because of his addiction to the company of bohemian writers, poets, musicians and mountebanks, Lord Oxford fell afoul of the taboos of his class Shakespeare in the "Sonnets" bitterly laments the loss of "good name" and social prestige This would account for the

Figure 11: **Shakespeare's signet-ring. Note under-surface shadows, plus broken surface outlines, forming design of a wild boar's head**

Figure 12 · **The original boar's head design of Figure 11, restored by outlining under-surface shadows on the matrix with white paint**

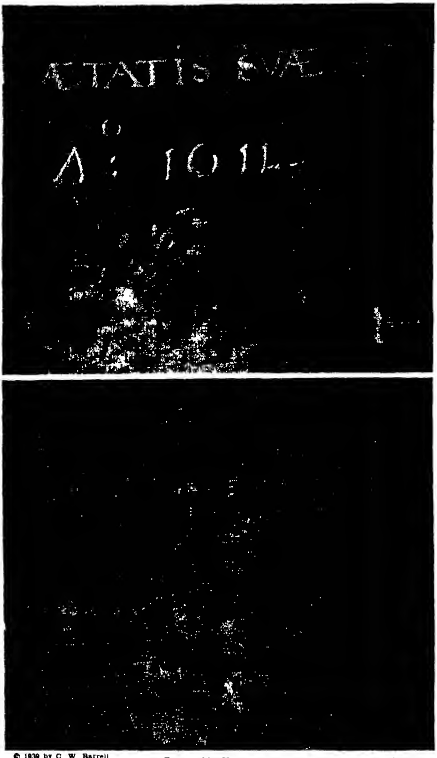


Figure 13 X-ray exposures covering inscription area of "Ashbourne" painting. Note under-surface remnants of original lettering; also family crest and shield of arms, with artist's monogram below phantom scroll

adoption of a pen-name by the author of such sentiments.

Through the courtesy and co-operation of the present Dukes of Portland and St. Albans, our investigation has been provided with complete technical descriptions and photographic copies of the only known paintings of the Earl of Oxford which bear his name, dates and personal symbols, undisguised. Study of these two pictures, Figures 1 and 2, in direct comparison with any one or all three of the dissected Shakespeare paintings, discloses not only an extraordinary similarity of the features in the original drawing but—allowing for the fact that different artists with different points of view turned out the works—an absolutely convincing repetition in physical color schemes Lord Oxford has reddish brown or auburn hair, a complexion merging from pink to carmine eyes of light hazel, that is, blue-gray with inner rings or flecks of copper, high-arched eyebrows, a Roman nose with well defined nostrils, a long upper lip a well cut mouth of generous proportions and mustache and beard running through shades of sandy-red to dark auburn.

Figure 15 The shield of arms of Lord Oxford's second wife. From the 16th Century Lane-Treutham monument in St. Peter's Church, at Wolverhampton, Staffordshire. Compare placement of the three griffins' heads in profile with remnants of the heads on the hidden coat of arms in the Shakespeare painting which X rays disclose

With the exception of a somewhat shortened nose and a partially bald head, the crude stone memorial effigy of Shakespeare which was set up on the wall of Trinity Church, Stratford, some time prior to the publication to the First Folio, originally displayed exactly the same facial color scheme that appears in the Lord Oxford portraits. We know this from a record made by

(Please turn to page 43)

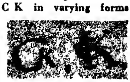


Figure 14 Left: Close-up of the X-ray monogram, C K *Below, center*: Cornelius Ketel's monogram from his portrait of Sir Martin Frobisher in Bodleian Library. *Directly below*: Two more examples of Ketel's monogram, showing his habit of combining the initials C K in varying forms

OUR POINT OF VIEW

Science Transcends War

JUST as two boys, starting from a trifling injury committed by one against the other, work themselves by progressions into a full-fledged fight—first a light slap, then a heavy swat, next a solid cuff, then a kick and soon a clinch with nothing dirty barred—so do two opposing nations at war work by downward steps into methods which do not bar hitting in the clinch, biting off ears or tips of noses and gouging out eyes The present war shows normal evidences of progressing in these directions despite the probable wish of each side that the play might be kept clean, so to speak; for in the nature of things, or until nations miraculously take to saying "You bit my ear off so we will slap your wrist, and then let's both change to calling names and making faces," this is inevitable

It is therefore a satisfaction to the scientific to observe that their own kind among the warring nationalities are not so childlike In the journal of world science, *Nature*, published in London, we find the following as a comment on the 60th birthday of the noted German physicist von Laue· "We take the opportunity to congratulate him on his brilliant scientific work which has led to the development of more than one new and important branch of science." The spirit of science.—*A. G. I.*

"As She is Spoke"

APOLOGISTS for slovenly use of the English language by many Americans say that such use is a sign of virility, of a healthy, growing language. Usage, they say, gives a patent of respectability The inference is that if slang words are not frequently adopted into the language and other words and phrases are not consistently misused, the language is decadent.

We disagree violently with these condoners of mental sterility and lassitude. We could cite scores of cases in point—from everyday speech, articles, business letters, novels—to show that sound English and robust words would have been more expressive and, certainly, less ridiculously infantile. But this journal is interested in the humanization of science, and so we will confine our remarks to one of our particular *betes noire* in that field. This humanization requires skilful, accurate reporting of facts, the use of apposite analogies, and such a simplification of technical description that the result will be lucid enough for the average newspaper reader's understanding. It is in this attempt to simplify a scientific subject that this beast often rears its ugly head

Over and over again one reads that something is "three times smaller than" something else when "one third as large as" was intended Or it may be "two thirds closer than" as the New York newspapers distorted the recent report from a great university that certain heavenly bodies were believed to be only "one third as far from" the earth as had been previously estimated

"Three times smaller!" "Two thirds closer!" How small is small? How close is close? One may as well ask the little boy's question "How far is up?" By what simple rule of arithmetic does one multiply downward, multiply a unit —whether it be a number or an object —and get a fraction thereof? There is nothing absolute about "small" or "close" Both, indeed, are abstractions, and we can see no sane reason for any writer to go through all sorts of mental contortions to give them new, definitive rôles. We have simple fractions already assigned to the jobs that would be foisted off onto such meaningless phrases. We should use them We should in fact, do everything in our power —we science writers—to make lucid for the layman, *and accurate*, the science which we wish him to think of as being human.—*F D M*

Accomplishment

OCCASIONALLY even a supposedly blasé editor, whose daily task involves participation in a critical survey of the passing parade of science and industry, stops short with a mental gasp of sudden realization Day by day he has seen in the parade examples of progress in some one industry, has accepted and helped to report them as part of the usual routine. Then comes the gasp. Something happens to make him acutely aware that these individual examples have coalesced into a whole, the implications of which are so far reaching as to challenge the imagination

Such has been the case with the plastics industry; the shock which produced the mental gasp was the recent announcement of the results of the annual *Modern Plastics* competition. For years Scientific American has followed the course of plastics through ashtrays and airplanes, industrial applications and home uses, yet nowhere has there ever before been brought out so vividly the impression which the entire plastics field has made on so many phases of our everyday life—at home, at work, at play

Here is an industry, if there ever was one, that owes not only its very existence but its present importance to individual initiative and a keen desire to produce new materials that will do old jobs better, as well as to create new products for new purposes First came Celluloid, made in an effort to replace ivory in billiard balls Then a long hiatus until Bakelite sprang from a laboratory marriage of two liquids and firmly established itself in the electrical field. Later developments with this last-named plastic opened new and varied uses for it Then came other plastics, other developments, other applications

This brings us to the latest *Modern Plastics* competition, in which over 800 entries made from a wide variety of plastics strove for the attention of the judges Here were displayed plastics parts for machine tools, large casings for various types of business machinery, beautiful decorative pieces in wide color ranges, molded door liners for refrigerators, plastics tools and dental plates, jewelry and automotive parts . Over it all hung a tremendously encouraging aura of progress, of accomplishment What the scientists of the plastics industry have done in creating new ideas is typical of the spirit of industrial progress that has made our civilization the worthwhile thing that it is today Our sincere congratulations to the men who have made possible this remarkable development; that they will attain even greater heights in the future is completely assured —*A P. P*

Air Power

AIR speed records don't always mean what they seem to mean. In the United States, the top speed of a plane is determined by flying a measured course, the plane entering the course from a level flight and continuing so In Germany, on the other hand, the plane enters the measured course *from a power dive* The Germans thus make it a handicap race favoring themselves!

Perhaps this fact may partly explain why 27 German Messerschmidts, supposedly such superior fighting planes, were so easily defeated (with nine downed and the other 18 routed) by only nine Curtiss fighters piloted by Frenchmen. And that brings up other conjectures. Has this "handicap method" been widely employed in estimating other aspects of Germany's air power? It may have been; and if so, it may explain Germany's few air successes in recent weeks. We wonder.

To Combat Noise

One Device Dissects Noises, Analyses Them . . . A Second Finds Vibration Sounds . . . A Third Determines Expansion of Metal Which Makes Hum

By JAMES A. BAUBIE

FOR decades men were too busy pushing along our industrial advance to be concerned seriously with new noises that came with new machines, these were a necessary evil, and that was that But in recent years they have come to learn that there is more to noise than the sound we hear Some noise is fatiguing to men and the machines they run It may seriously affect normal digestion of persons continuously exposed to it and it frequently is a sign that the machine is not performing all of the work of which it is capable

In noisy industrial employment it is not unusual to find as many as 50 percent of the workers under 30 years of age with some degree of impaired hearing, according to Dr Carey P McCord of Detroit, chairman of a special noise study committee of the American Medical Association In addition to ear injuries, this authority points out, there are many more scarcely measurable effects such as loss of sleep excessive fatigue, and emotional disturbances, which are brought about by noise Fatigue caused by noise probably effects the initial injury to the ear in such cases of industrial deafness, the doctor states, with the changes taking place in the tissues of the ear, their location and extent of damage depending on the type of noise and the duration of the exposure

STUDIES have indicated that high pitched tones are more damaging to the health of workers than low pitched tones The din in a boiler works is more injurious than the lower-pitched roaring in a cotton spinning mill The report of small caliber artillery and machine guns is more injurious than the boom of heavy cannon

All recent noise studies indicate not only that workmen do better work when freed from the most disturbing noises but that most of us would lose some of the jitteryness of 20th Century living if we were inoculated with a little more quiet

Now, consider the machine for a moment Sound is the result of something vibrating within the audible range We hear it because the vibrating object causes alternate expansion and contraction of the atmosphere surrounding the object, and these pressure changes are transmitted in waves to all points in the neighborhood of the source of the sound, exerting a pressure on any object, such as an eardrum, within its sound field If the vibrations are excessive and are coming from a machine, they are more than likely a warning that the machine is laboring under some difficulty, is not working efficiently

As a result of these demonstrably harmful effects of noise on the tools of industry the worker, and in fact the entire citizenry, engineers physicians and municipal administrators are battling noise today as never before attacking it in hundreds of laboratories and council chambers Dr McCord is of the opinion that 90 percent of industrial noise could be reduced to one half of its present intensity, if the causes of noise were discovered and corrected.

Today this goal is within the realm of possibility partly because of the work of a group of research engineers in a dozen laboratories of the Westinghouse Electric & Manufacturing Company Out of these laboratories has come a mechanical detective to search out unwanted sounds This noise detector, developed by W O Osbon, not only measures the intensity or loudness of a sound but diagnoses its noise, separating it into its different parts and measuring the pitch and intensity of each part

The noise analyzer looks and acts something like a radio receiving set of an earlier vintage On its panels are

Co-developer of the Dynetric Balancer which sees and feels where and how much a rotor is off balance, F. C. Rushing focuses a Stroboglow lamp on a rapidly revolving rotor

The inventor of the portable noise analyzer, W. O. Osbon, right, is shown measuring and diagnosing the noise inside a motor coach. This is the machine that breaks noises into all their parts for close study

switches, dials, and meters. Inside are vacuum tubes, condensers, and transformers. But to understand how it works, it is first necessary to inquire a little more into the cause of noise

Technicians in the science of sound have agreed upon a barely audible sound of 1000 vibrations a second as their standard of reference Such a sound as this presses upon each square centimeter of an eardrum with the force of one five-thousandths of a dyne or approximately three billionths of a pound per square inch As the sound increases in loudness, the pressure exerted on the eardrum increases tremendously For example, if a barely audible sound of 1000 vibrations is increased in loudness to the threshold of pain it will exert a force of 3000 dynes or about one twentieth of a pound per square inch Its pressure has been increased about 15 million times

The control panels of the unique device which measures the lengthening effect of alternating current on magnetic metals, and developer S L Burgwin

Half the size of a dime, the tiny mirror at the left reflects a light beam into photo-electric cells to measure the amount of "stretch" of steel The mirror is on a needle which rolls under the bar to the right of the pincers

BUT pressure or intensity alone does not determine the loudness of a sound This depends rather upon the combination of the sound's frequency (number of vibrations) and its intensity If two sounds are of equal loudness but have different frequencies, the one with fewer vibrations will in general, have a greater intensity at its source and exert a greater pressure on the eardrum.

The human ear is sensitive to a range of frequencies from 16 to 22,000 cycles a second, but is most sensitive between 1000 and 5000 cycles If the intensity of sound increases 10 times, its intensity level rises one bel, in acoustical terminology. The decibel is one tenth of a bel Some noises become so intense that they are felt as well as heard; they are then said to be on the threshold of feeling This occurs only in the upper limit of audibility, near 120 decibels for some sound frequencies. The purring of the family cat rates about 25 decibels A pneumatic drill at a distance of 10 feet produces a noise level of about 90 decibels

These are the elements of sound that are tuned in by the noise analyzer The frequency of every component or contributor to noise is balanced by this hearing mechanism against its own mechanical filter's frequency of 7000 vibrations a second

As the sound engineer sweeps through the analyzer's frequency range, its decibel dial indicates loud noises at specific frequencies, instantaneously recording all the varying contributors to the total noise output of a machine or apparatus under examination It singles one element out of a dozen possible elements that make up a noise

Already the supersensitive ears of the analyzer have uncovered elusive noises in street cars, airplanes, trains, and electric motors It has separated the motor's noise, diagnosing it and placing the blame where it belongs It tells how much noise is caused by unbalance in the rotor, how much by the commutator bars and the slots in the rotor, and what part is gear noise

Housewives usually have scant interest in rotors, generators, and the machine noises of factories, but today they have the analyzer to thank for the quiet operation of their electric refrigerator, washer, ironer, vacuum cleaner, and many other small motor-driven home appliances In all these, the analyzer has done yeoman's service in uncovering noise sources

In another laboratory at East Pittsburgh, engineers recently set a new electrical sleuth on the trail of noise It is a dynetric balancing machine, developed in part by F. C Rushing, which routs noise by detecting vibrations resulting from states of unbalance in rotors, which are the whirling parts of motors and generators "Unbalance" is a first cousin to noise

STILL another newcomer to the ranks of noise detectors is a device developed by S L Burgwin, a Westinghouse research engineer, as a means of studying the property of magnetic metals to lengthen and shorten in an electromagnetic field Engineers have long known that in most electrical machines using alternating current the iron is first magnetized in one direction, demagnetized, and then magnetized in the opposite direction Frequently the resultant lengthening and shortening of the metal set up vibrations which create midget pressure waves in the air, audible as buzzing or humming noises

In working out his machine, Mr. Burgwin sidestepped several handicaps by developing an "electric eye" yardstick, using direct current to measure the simple change in length of steel test strips, detecting improvements and failures in new electric metals Stripped of its technical dress, this measuring machine consists principally of a tiny roller, about the size of a darning needle, on the end of which is fastened a mirror about half the size of a dime A divided photo-electric cell and a light beam complete the setup

When a test strip is placed on the roller and magnetized by direct current, it lengthens The light beam focused on the mirror is reflected to the photo cell, registering the amount that the roller turns, determining the elongation of the test strip The deflection of the light beam may be as small as four ten thousandths of an inch at a distance of about 39 inches from the source of the light beam, by using a galvanometer, the photo-cell magnifies this deflection 100 times makes it readable

Fifteen years ago engineers knew very little about noise Paradoxically, they learned how to stop noise by developing means of producing it in radio receivers, virtually building the modern science of sound around the radio microphone. From this beginning the industrial research laboratories have come to solve noise problems that were not even dreamed of in 550 B.C, when Pythagoras founded the science of sound with his mathematical explanation of the musical scale

Dust Clouds of Space

By HENRY NORRIS RUSSELL, Ph.D.
Chairman of the Department of Astronomy and Director of the Observatory at Princeton University Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington

SINCE Barnard's classic work, more than 20 years ago, it has been realized that the dark "rifts" and "lanes" in the Milky Way, and the smaller black spots which are found here and there, are not gaps or holes in the star clouds, through which we look into the black depths of space beyond. They are obscuring clouds, which lie in front of the stars and hide them

If a cloud of this sort were perfectly opaque, we might expect it to appear as a black, starless spot in the heavens, and so it would, if it were only a few light-years away But a black cloud at a distance of 100 light-years or more would have many stars in the clear space in front of it, and these would appear scattered over the dark patch in the sky. But if the cloud were only partially opaque we would also see, in the obscured region, stars lying behind the cloud, diminished in brightness by the absorption of their light but not extinguished

How may one distinguish between these two possibilities? The task would be easy, if the stars were all of the same real brightness, for then the apparent brightness would be a direct clue to the distance If a black cloud lay at the distance at which the stars (on our momentary assumption) would appear of (say) the eighth magnitude, we would find as many stars brighter than this limit in this part of the sky as elsewhere, and none at all which were fainter But if the cloud let through one sixth of this light—that is, made a star seen through it appear two magnitudes fainter—the stars behind it, at such a distance that they would appear, in clear space, of magnitude 9, would be reduced to magnitude 11, and so on. We would still find faint stars in the region but in reduced numbers—as many tenth magnitude stars per square degree as there were twelfth magnitude stars outside, and the like By simply counting the number of stars, for equal area, inside and outside the obscured region, we could thus find very easily the distance and opacity of the cloud

Actual conditions are, of course, much less simple—the cloud may be a thin fog, extending to a great depth and obscuring more and more the stars which lie deeper in it; and the stars themselves differ enormously in real brightness. These complications—especially the second—smear out the sharply defined effects which would appear in the first case, and make the calculations much more complicated. But, with accurate observations of the brightness of stars in obscured and unobscured regions—numerous enough to get good average values, and running down faint enough to get away from most of the smearing effects—it is possible to determine pretty reliably the distance, the total absorption and even the thickness of the foggy region We must start with knowledge of the relative numbers of stars of different degrees of real brightness, in the same volume of space, but this can be found in other ways.

It is rare to find a really black cloud There are a few spots where hardly 1 percent of the light from behind gets through, but in most regions—such as the Coal Sack near the Southern Cross—the background stars are still visible but appear reduced to from a quarter to a tenth of their proper brightness The total light of all the stars—except the foreground—is reduced in this proportion so the dark patch will be conspicuous, provided that it is near enough to us so that the "foreground" stars give only a moderate percentage of the whole light This happens, in the Milky Way, for clouds which are only a few hundred light years distant. But a cloud—even a very big and black one—two or three thousand light-years away would have such a lot of unobscured stars in front of it that its existence would not be obvious, and careful counts of stars, down to very faint magnitudes, would be required to find it.

THERE is one way, though, in which these distant clouds can be detected They hide the spiral and other extragalactic nebulae, which lie far, far away, enormously outside the outermost confines of our own Galaxy. It has been known since Herschel's time that very few such nebulae were found in the parts of the sky near the Milky Way, and Hubble, by detailed surveys, has mapped out a "zone of avoidance" extending all around the heavens in which none at all of these distant bodies can be observed. Evidently, in the outer regions of the Galaxy, or perhaps beyond most of its stars, there must be gigantic obscuring clouds, which shut out hopelessly from our sight a great portion of the remoter Universe There are a few places, though, not far from the central line of the Milky Way, where Hubble has photographed extra-galactic nebulae. Here there must be "holes" where the incoming light passes between the clouds, whether near or far, and reaches us.

These obscuring clouds are the hugest things known to astronomy, except the great spiral nebulae themselves. Even our near neighbors among them—in our own Galaxy and but a couple of hundred light-years away—have length, and breadth and thickness which must be measured in light years

Their enormous size, however, must be compensated by an excessively low density The only known thing which can be at the same time so rarefied and so opaque is an enormous, thin, cloud of dust. An easy calculation shows that the light-obscuring power—per pound per million cubic miles — becomes greater and greater, if we imagine the material in the cloud to be broken up into finer and finer dust, until the dust particles are reduced to a diameter of about 1/150,000 of an inch—so that their circumference is equal to a wavelength of light Still smaller dust gets a decreasing grip on the light-waves and the opacity rapidly diminishes as it gets finer.

When we say that the obscuring clouds are composed of such fine dust, we do not mean to suggest that other particles may not be present—from chunks like meteorites down to minute dust and separate molecules of gas—but that the dust particles of diameter roughly from 1/30,000 to 1/300,000 of an inch are so very much better smoke-screen-forming materials per pound that they will take over practically the whole job, unless the general mixture should have a much smaller percentage (by total weight) of particles of this size than of the others.

There is an important difference, though, in the properties of a cloud, according as it is composed of particles decidedly larger than 1/150,000 of an inch, of particles decidedly smaller, or of a mixture of both.

In the first case, the obscuration is by ordinary opaque-body obstruction, and light of all colors is affected to the same degree. In the second, when the particles are much smaller than the waves of light, they have far more influence in scattering short waves than long, and the blocking power varies inversely as the fourth power of the wavelength For red light, say of 6300 ang-

Despite Unavoidable Complications, It Has Proved Possible to Determine the Distance, Light Absorption, and Size of These Obscuring Clouds

stroms, the effect is only one fifth of that for violet light (4200 A)

Now it has been known for many years that a good many stars in obscured regions of the sky appeared abnormally red This adverb suggests another complication Stars of different temperatures naturally give off light of very different average colors, but, fortunately, there is a close correspondence between the color and the type of spectrum as defined by the lines in it By finding the normal color for stars of each spectral type, in regions clear of absorption, we can get standards with which to compare stars in the obscured regions, and, fortunately, we have a good test for freedom from absorption—namely the visibility of extra-galactic nebulae The "color excess" measures directly this abnormal reddening and hence that part of the obscuration which varies with the wavelength

An admirable research of this sort has just been reported by Stebbins, Huffer, and Whitford, who have for years been making highly precise photometric measures with photoelectric cells, first at the University of Wisconsin, and later also at Mount Wilson It has been no small labor their present paper summarizes results derived from observations of 1332 stars, all of spectral class B. This class includes many of the brightest of all the stars and so affords a powerful method of carrying the investigation to considerable distances.

WORKING with two color filters, transmitting violet light of average wavelength 4170 A, and bluish-green at 4710, and with a thermionic amplifier to magnify the minute photoelectric currents, they have made precise measures of stars fainter than the tenth magnitude, though in general they stopped at about the ninth The color excess of a star thus measured has a probable error of 0 01 to 0.02 magnitudes—about 1/50 of the difference in color between Vega and Arcturus, which, on their scale of measurement, is 0.7 magnitude.

Outside the Milky Way, and, indeed, in the portions of it well away from the central line, there is not much abnormal reddening. The strongly reddened stars are close to the central line, and a plot of these alone would suffice to map out the galactic circle Moderately reddened stars (with a color excess less than 0.30) are found all round the Milky Way. But the strongly reddened stars not only cluster close to this circle, but are numerous in the region of Sagittarius (which lies in the direction of the galactic center) and are absent from a long stretch of the Milky Way in the opposite part of the heavens, where we are looking away from the center, and toward the edge of the great, roughly disk-like assemblage of stars It is close to the center that the reddest B stars are found One has a color excess of $0^{m}67$; that is, though it ought normally to be whiter than Vega, it looks almost as red as Arcturus

In both parts of the heavens, strongly and slightly reddened stars of nearly the same apparent brightness are found suggesting that the obscuring clouds are patchy, with some nearly clear gaps between them This is confirmed by a detailed study of regions where bright star clouds lie close to dark and obviously obscured regions In the bright patches, the stars are slightly reddened indicating that there is some absorption all over this part of the sky In the moderately bright regions adjoining, the B-stars are conspicuously redder—the absorbing layer is denser—while in the darkest regions no B-stars are found at all. The obscuration has made them so faint that they drop below the limiting brightness of the survey

SO far, we have considered only the effects of these clouds in reddening the light which passes through them It is of great interest to find, if one can how much they weaken the light of various colors To attack this problem Stebbins and his associates have chosen pairs of stars close together in the sky and with very similar spectra, one of which was abnormally red and the other not. If the spectra are substantially identical (as regards the intensities of the lines) we may assume that the real temperatures, and colors of the light are substantially the same These pairs of stars were then observed with a spectrophotometer, measuring the relative brightness of the two in many separate small regions of the spectrum To measure these small separated parts of the radiation of a seventh-magnitude star must have demanded extraordinary precautions, the authors only remark "A cesium oxide cell refrigerated with dry ice was used "

The reddened stars, of course, give relatively more red light; but, when the excess brightness was plotted against the wavelength, it became evident that the rate of change with color was not nearly as great as it would have been for an absorbing cloud composed entirely of gas and exceedingly fine dust The variation was not inversely as the *fourth* power of the wavelength, but inversely as the *first*. This is not theoretically troublesome—it can perfectly well occur for light which has traversed a mixture of dust particles of varying sizes But the practical consequences are interesting With this law of variation the obscuration is only 13 percent greater for violet light than for blue green For visual light (λ5100) the absorption is a little less; but it is seven times the differential effect which produces color excess For the most highly reddened stars, with a color excess of $0^{m}6$, the obscuration of their visual light would exceed four magnitudes—if the clouds could be cleared away they would look 50 times brighter. In the Milky Way in Sagittarius, even the bright cloud, where the color excess E is 0 10, loses half its light by passage through the obscuring veil between it and us This may not really be a star cloud at all—only a region seen through a "window" On the edge of the dark area, $E = 0$ 4, only 4 percent of the light gets through

THE absorption has to be considered in calculating the true brightness of these stars Allowing for it (on a basis of the observed color excess) Stebbins and the rest conclude that the "earlier" and hotter B-stars are about 30 percent brighter than had previously been supposed. The brightest of all are the so-called C-stars, with very sharp lines, like Rigel or Alpha Cygni, which come out 12,000 times as bright as the Sun

Allowing for the absorption, our authors calculate that the most heavily obscured stars in Sagittarius are at distances of 1200 and 1500 light-years. In the bright cloud, we can see through the "window" as far as 3500 light-years—and probably to fainter stars beyond In the opposite part of the sky, the situation is curious Stars at moderate distances, not exceeding 2000 light-years show a reddening of $0^{m}3$, corresponding to an obscuration of 85 percent of their light But stars with the same spectrum and much fainter, are no redder It looks as if the absorbing clouds stopped at about 2000 light-years' distance, and space beyond, up to 6000 light-years, was practically clear

This is a powerful method of investigation It has been carried about to the limit for the moment, because the spectra of the fainter and more distant stars have not yet been catalogued It will be of important service in the great task of mapping the observable portions of the Galaxy—in distance as well as direction—and also the obscuring barriers that prevent us from seeing farther.
—Princeton, November 6, 1939

Our Superior Modernized 75's

Re-Construction of Our Large Stocks of Wartime 75mm Guns Would Give Them Longer Range, High Elevation, Wide Traverse . . . Work is Inexpensive

By G. M. BARNES
Lieutenant Colonel Ordnance Department U S Army

THE 75-millimeter gun, as modernized by the Ordnance Department of the U. S. Army, has been called by military men the best divisional field piece in the world today. Its range is 13,000 yards as compared with 7000 yards for the wartime model. Its arc of fire is 14 times greater, hence it may be expected to make many more hits on a moving target such as a **tank**.

Modernization of these guns costs $8000 each as compared with the $25,000-cost of manufacturing one 105-millimeter howitzer, toward the use of which there is now a definite trend. In the accompanying article, Colonel Barnes says, simply, we have "a very large supply of" the old 75's on hand. Another authority said recently that we have enough of them, with great quantities of shells, to supply a sizeable army in the field. —*The Editor*

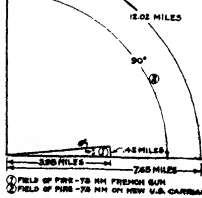
IN the early days of World War I, newspapers and magazines gave colorful reports of the startling successes achieved by the German Army in their rapid march through Belgium and France toward Paris. These accounts told of the great destructive power of the German guns and howitzers. The world was introduced to the new German heavy howitzers which quickly accomplished the destruction of the fortifications at Liege, Belgium. Of all the belligerents involved in World War I only the German Army was adequately equipped initially with all the necessary types and calibers of artillery. The French and British lacked artillery and were particularly deficient in heavy types. The great destructive power of the German artillery can be gleaned from statistics of casualties. These statistics record that the German armies produced nearly twice as many as the allied forces and this was due, in great part, to the predominant power of the German artillery.

It was during these days of the World War that Americans first began to hear about the French 75mm gun, known as the "Soixante quinze." It is scarcely an exaggeration to say that this gun stemmed the on-rush of the German armies in the early days of the war, preventing the rout of the French armies.

The French 75mm gun had been developed secretly and adopted in the year 1897. Its construction was a military secret which was successfully kept from the Germans. Contrary to popular belief, the great importance of this gun did not lie so much in its superiority as a piece of artillery, as in the fact that the French had an adequate supply of this one caliber. It was, however, a very excellent division gun of great reliability. The secret feature was the hydro-pneumatic recuperator which gave the gun stability and smoothness in firing. In this respect, it was superior to the German 77mm field gun.

At the time the United States entered the World War in 1917, it became known for the first time to the American people that our Army possessed but 900 pieces of mobile artillery of all calibers. This number did not include the splendid permanently emplaced seacoast artillery which had been provided for the defense of our country against naval attack. General Crozier, then Chief of Ordnance, and other Ordnance officers, had pleaded with Congress for years to provide an adequate supply of mobile artillery for the army, but prior to 1917 there was little interest in this subject. When the United States entered the war, our troops were equipped with a few 3-inch field guns, model 1902. This was an excellent piece of artillery and when tested by experts in comparison with the French 75mm, was held to be the equal, if not the superior of the French gun. In addition, a new type of American field gun known as model 1916 had just been tested at the Sandy Hook Proving Ground. It outranged the French gun and also had greater lateral traverse. At that time, the French, having been in the war for about three years, were manufacturing large numbers of 75mm guns and were in a position to sell to the American Government the number required for arming our troops as they arrived in France. Furthermore, as we were to co-operate with the French, there would be an important advantage in using the same caliber of ammunition which could be interchangeable. The British Army went to France with their 18-pounder field gun and were consequently not able to exchange ammunition with the French. The important decision was made in June 1917—and it appears now that this was a very wise decision—to abandon our 3 inch field piece, to manufacture a few model 1916 guns rechambered for French ammunition; but to manufacture mainly the French 75mm field gun and ammunition in this country, in addition to procuring an initial stock of guns and ammunition from the French Government. As a result of this action, the close of the World War found this country in possession of a very large supply of 75mm French guns.

AFTER the Armistice, studies were made by Boards of Artillery and Ordnance Officers of the artillery lessons of the war. The consensus was that a longer range field gun should be developed for use in the next war. Consequently, several years of research and development ensued during which a number of models of guns and gun carriages were manufactured. Some of these model 75mm guns were found to be most excellent and greatly superior in range to the famous French 75mm



Range, elevation, and traverse of old and new 75mm guns compared

Released for publication by the Chief of Ordnance U S Army. Statements and opinions are to be understood as individual expressions of their author and not those of the Ordnance Department.

gun However, realizing the large stocks of 75mm guns available in the country, Ordnance officers could not refrain from casting backward glances at this important stock of artillery and wondering if ways and means could not be found whereby these guns could be utilized.

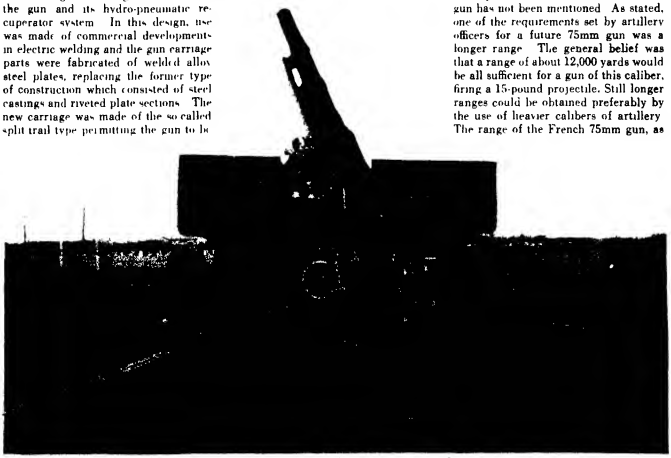
The first step in this direction was to remove the wooden wheels from the 75mm gun carriage and to replace them with rubber tired wheels having roller bearings at the axles The carriage was thus *high speeded* and converted from a horse-drawn vehicle, capable of traveling at a maximum of 15 miles per hour into an artillery unit which could be drawn by a truck at speeds of 40 to 50 miles per hour One type of modification was successfully worked out by the Ordnance Department, and another along the same line, known as the Martin-Parry Adapter, was found equally satisfactory A considerable number of the latter units were manufactured by the Martin-Parry Company and placed in service

While this modification permitted the gun carriage to be drawn at high speeds it was only a partial answer to the problem, since the range and horizontal traverse of the gun had not been increased The next step was to build a complete new carriage for the 75mm gun utilizing both the gun and its hydro-pneumatic recuperator system In this design, use was made of commercial developments in electric welding and the gun carriage parts were fabricated of welded alloy steel plates, replacing the former type of construction which consisted of steel castings and riveted plate sections The new carriage was made of the so called split trail type permitting the gun to be elevated between two trails and allowing a high angle of elevation—45 degrees The angle of traverse of the gun at the same time was increased from 6 degrees, permitted by the French carriage, to 90 degrees, obtainable with the split-trail carriage An idea of the increase in range and traverse of the new weapon so found can be gained by reference to the accompanying drawing

In this recital of the improvement which had been taking place in the carriage for the field gun, the concurrent development in the ammunition for this gun has not been mentioned As stated, one of the requirements set by artillery officers for a future 75mm gun was a longer range The general belief was that a range of about 12,000 yards would be all sufficient for a gun of this caliber, firing a 15-pound projectile. Still longer ranges could be obtained preferably by the use of heavier calibers of artillery The range of the French 75mm gun, as

Somewhere in France during the World War Americans manning a French 75 The gun has just been fired and shell case in the air is being thrown aside

The carriage was high-speeded in this first modernization step Split trail not yet added



The 75mm gun on its new carriage — elevation 45 degrees; traverse 90 degrees, range over 13,000 yards

The gun, as modernized, is an excellent anti-tank weapon because its traverse of 90 degrees permits point-blank or distance fire over a wide fan-shaped area

used during the World War was approximately 7000 yards. Through a combination of changes in the design of the carriage permitting 45 degree elevation and by the improvement of the ballistic shape of the projectile, this range has been increased to over 13,000 yards. The design of the projectile has been refined by giving a better streamlined shape, and the resistance of the projectile in passing through the air has been greatly decreased. Thus, at a very small cost, it has been possible to convert our stocks of 75mm guns remaining from the last war into new weapons fulfilling all the service requirements for a modern division gun.

THE mission of field artillery is to assist the other arms, particularly the infantry and cavalry, in combat by fire power. In carrying out this mission the division gun is used to produce many types of fire: destructive fire to render the target useless, neutralization fire for the purpose of lowering the fighting efficiency of the enemy personnel by inflicting severe losses, concentration fire by means of which a concentrated volume of fire is laid over a limited area, the various kinds of barrages, such as the standing box and rolling types.

In recent years a new target requiring another kind of fire has appeared upon the modern battlefield—the high speed tank. Most modern armies are now equipped with tanks capable of moving across country at high rates of speed, and are prepared to use these tanks in making mass attacks against opposing forces. Tanks now have been developed to the point where machine guns and other hand-carried weapons are no longer effective against them. Weapons of special design, such as the 37mm anti-tank gun, are required to penetrate tank armor. When tanks are used in large numbers there will usually be a deficiency of anti-tank guns to meet these mass attacks. Consequently every available weapon must be utilized to assist in stopping them. The 75mm gun on its new carriage forms a very effective anti-tank weapon.

It will be appreciated that the French 75mm gun carriage with its limited traverse of 6 degrees could not have been employed for firing at a tank travelling across country at 15 to 20 miles per hour. It would have been impossible to shift the trail of the gun from one position to another rapidly enough to follow the movements of the target. The new gun carriage with its traverse of 90 degrees makes possible a type of fire with the 75mm gun not heretofore obtainable. The drawing shows the great field of fire which can be effectively covered with the 75mm gun. Artillery in most situations, would be emplaced some distance behind the position of the 37mm anti-tank guns. But assuming that the tank attack should pass the line held by the anti-tank guns, the ability to bring rapid, effective fire upon high-speed tanks with the 75mm gun greatly enhances the value of this weapon in modern warfare.

To make this discussion of the division gun more complete, it should be stated that most armies, including our own, are now adding another division weapon to supplement the fire of the 75mm field gun—the 105mm howitzer. The advantages of the howitzer are principally increased weight of projectile—double that of the *gun* projectile, giving at the same time the almost equivalent range of 12,000 yards for approximately the same weight of weapon, and the further advantage of a plunging type of fire. As the enemy usually seeks concealment behind slopes and hills, the howitzer, through its curved-trajectory projectile, can bring more effective fire to bear than a flat trajectory gun. While it may be said that the trend in division artillery is toward the use of more 105mm howitzers, the new battlefield requirement for use of division guns as anti-tank weapons assures the gun of an important new role on the battlefield of today.

Science and modern engineering have thus made possible conversion of our large and valuable stock of 75mm guns into modern division guns. These new weapons will meet all service requirements as to power and mobility. Through re-design the gun has become an anti-tank weapon of first importance. These 75mm guns, augmented by powerful 105mm howitzers, will provide for the American Army artillery second to none.

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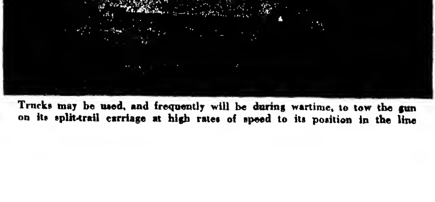
Colonel Barnes' article is vastly important since it indicates that we have an ace in the hole to help scare off would-be aggressors. Other "aces" have been discussed by us previously, still others are yet to be explained to our readers. Soon to come, for example, is an article by Acting Secretary of the Navy Charles A. Edison on the power plants of the new destroyers. Another will be on tanks and Army mechanization in general. Look for them.—The Editor



Trucks may be used, and frequently will be during wartime, to tow the gun on its split-trail carriage at high rates of speed to its position in the line

In this air conditioned, scientifically lighted plant are 700 workers, and offices and engineering departments

Controlled Comfort For Workers

THE world's first designed windowless factory, in which working conditions are constant and unchanging the year 'round, is in operation in Fitchburg, Massachusetts. Lighting was scientifically designed to give optimum visibility at all tasks, air conditioning provides the highest degree of physical comfort for workers, exhaust fans and ducts carry away dusts and heat of all operations, and color plays an important part in maintaining worker morale and promoting efficiency. The plant is that of the Simonds Saw and Steel Company, and was designed, built, and installed by The Austin Company. It was begun in 1931 but held up during intervening years because of the depression.

The Simonds company has concentrated in this five-acre room all the operations formerly carried on in three old plants totalling 17½ acres. These include everything from forging and heat-treating of steel to the sharpening and shipping of saws, machine knives, files, and other cutting tools.

The blanket of "cold" light, which is laid over everything by the more than 1400 100-watt fluorescent tubes, never varies, assures each employee absolute uniformity of light at his job at all times.

Manufactured "north light" is supplied where it is most needed in the great partitionless factory room

Eight self-contained production lines, each with a complete sequence of heat-treating to finishing facilities, function smoothly in the five-acre room

The atmosphere inside the plant is kept clean, cool, and comfortable despite the presence of some 70 heat-treating furnaces and more than a thousand individual motor-driven grinders, cutters, and other machines which are in almost constant operation and throwing off heat, dust, and smoke.

Five changes of air per hour are provided by large air-conditioning units which circulate 400,000 cubic feet of air per minute through 3000 feet of overhead ducts.

Special foundations and shock and sound-absorbing insulation isolate the noise and vibration of four big drop hammers as well as dampening other factory noises and even the sound of voices in the offices. All machines are painted a bright yellow, all furnaces and benches are painted with aluminum, all steel columns, stairs, walkways, and the ceiling are a light cream

ELECTRONS DANCE THE RHUMBA

Klystron, Generator of Powerful Ultra High-Frequency Radio Waves . . . Useful in Blind Landing System for Planes . . . Other Possibilities

By ANDREW R. BOONE

DOWN the lower side of a cigar-shaped radio beam, an airplane flown by Capt Milton M Murphy and Jack Haynes, Civil Aeronautics Authority inspector, glided repeatedly to safe landings on East Boston airport in Massachusetts recently These flights demonstrated for the first time a practical application of the klystron, an invention developed by scientists at Stanford University which generates ultra-short radio waves that can be directed as a searchlight directs a beam of light The radio waves are sent out from a copper antenna which has only the thickness of a match and is but four inches long

The klystron, which promises to revolutionize certain phases of, and to bring greater safety to, airplane operation, is an ultra short-wave, ultra high-frequency radio generator Radio experts have called it "the most important advance in radio since Lee De Forest invented the audion tube in 1908"

Sigurd Varian, one of the inventors of the klystron, adjusting one of the two rhumbatrons that produce ultra high-frequency waves

Already, in the laboratory and on the airport, the klystron has demonstrated its ability to produce waves of a strength hitherto unattainable in high frequency apparatus, waves which are only one tenth as long as any previously used These waves may be focused and directed along an almost straight line, and pilots receiving them are not confused by a jumble of signals from several sources

THE story of how the klystron was created, what it is, and how it operates at frequencies almost beyond comprehension involves a Pan American Airways pilot, a television engineer, and a professor of physics

Some time ago William W Hansen, Stanford University physicist, was attempting to develop a new kind of atom smasher Instead of the usual type of coil-and-condenser resonator he devised a method whereby radio waves could be made to surge back and forth within a copper tank. Because the rhythmic surging reminded a laboratory assistant of the rhumba, the little copper tank was dubbed the "rhumbatron."

Scarcely had the physicist announced this device when Flight Captain Sigurd Varian, who for eight years had been piloting fast land planes over Mexico and Central America, heard of it While bucking storms over Panama and Guatemala, Varian realized aviation's greatest needs were for a successful blind landing system and for an absolute terrain clearance altimeter Ultra-high electrical frequencies, he thought, held the secret Perhaps the rhumbatron was the answer

Shortly Varian and his brother, Russell, who had been doing research on television, became research associates at Stanford Russell supplied ideas, Sigurd tried to work them out One big problem was how to supply energy to the rhumbatrons at the very high frequencies needed After many ideas that had to be abandoned, Russell finally thought of a simple way to excite the rhumbatron circuit and a working model was built Professor David L Webster, executive head of the physics department, became interested and, among other things worked out the mathematical theory of the process Soon a design was evolved for the klystron—a high-power generator using two rhumbatrons—models were built, and the invention was ready to be shown to the world

What had the inventors created?

The klystron ultra high-frequency generator utilizes the fact that an electric field inside a rhumbatron can be made to influence the speed of electrons In operation a cathode emits a continuous stream of electrons. Surging forward under the impetus of 3000 volts, these speed through the first rhumbatron

Russell H. Varian (left) and Prof. W. W. Hansen, conducting tests with one of the complete assemblies of two rhumbatrons sealed within an evacuated casing

at nearly 20,000 miles a second. This rhumbatron causes the speed of some electrons to increase slightly, forces others to slow down, while intermediate electrons race forward with unchanged speed Leaving the first rhumbatron, known as the "buncher," the electrons speed down a short copper tube, and by the time they reach the second rhumbatron, called the "catcher," the faster electrons have caught up with the slower electrons preceding them, to form bunches The bunches successively pass through the catcher at a frequency of three billion cycles per second, or even more Through delicate synchronization of the buncher and catcher, the bunches are timed to go against an alternating current field within the catcher This resistance causes the electrons to lose their energy of motion which instantly becomes converted into high-frequency electrical energy Thence this energy flows to the tiny antenna

Ultra high-frequencies are transmitted from the tiny antenna projecting through the disk Antenna length is adjusted by sliding the copper tube on the rod

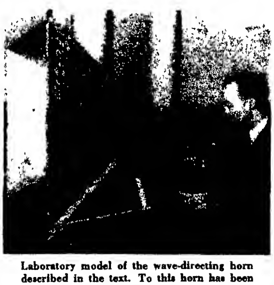
ONLY when the two rhumbatrons are synchronized will the pulsing electrons produce power Tuning is accomplished by turning a micrometer screw which adjusts the distance between two grids through which the bunched electrons flow

Recently I observed, while visiting the Stanford physics laboratories, a startling demonstration of this machine's power One by one Professor Hansen brought several types of lamps into the beam Seven ordinary 60 watt globes, to which short receiving antennas had been soldered, glowed brilliantly when brought near the reed-like mast "This," he pointed out, "will give you an idea of the amount of power produced" Two fluorescent lamps were held near the antenna, one parallel and the other at a sharp angle The former remained unlighted, while the second gave out brilliant light, demonstrating graphically the wave's polarization Again, Hansen held a filament light in position, and the filament glowed in alternate four inch sections. Here I saw the standing wave patterns, each light and dark space representing one quarter of a wavelength.

This was, of course, a laboratory display. The tests at East Boston served as proof of the pudding. During these flights, the same antenna flashed the signals that guided the airplane earthward. It was a sort of preview of more startling innovations to come.

Other scientists enter the picture here. Irving R. Metcalf, head of the Civil Aeronautics' Authority technical division had evolved an idea for improving blind landings He laid the problem before Professor Edward L. Bowles, Massachusetts Institute of Technology electrical engineer As a result a system was developed which involved transmission of two radio waves from the same spot

The system however, possessed too little power, so the eastern experimenters called upon the western inventors for help A klystron, built at Stanford by J R Woodyard, a graduate student, was flown east to Boston At the East Boston airport it was connected to an ingenious horn invented by Professor W L Barrow, another M I T electrical engineer This device made possible the transmission of a highly directional beam of radiation The beam's characteristics can be explained this way As the radio waves leave the horn, they lose intensity, in accordance with well known laws At any particular distance from the source the greatest intensity will be found on the axis of the beam Now the pilot's blind landing instruments are adjusted to indicate to him a path of equal wave intensity Thus, if one thinks of the pilot as being on the beam axis at a point, say, 500 yards from the radio source, then in order to follow, by his instruments, the path along which the radio intensity will remain the same as at that point, he must drop below the axis and follow a slightly curved path since obviously the equal intensity path must depart from the axis The shape of this path may be thought of as like that of the surface of a cigar Advantage of the path created by ultra-short waves is that its curvature permits the pilot to glide fairly evenly to the ground



Laboratory model of the wave-directing horn described in the text. To this horn has been adapted the klystron high-frequency generator

IN the future, Sigurd Varian believes, "sandwich" landings will be feasible, in which the pilot glides down a straight-line path along which the signals from two beams are equal He thus will be "sandwiched" between the upper and lower beams emerging from two horns, one tilted higher than the other. So precise will be the path formed by the two beams that the pilot will need only to start down at a safe rate of descent and by consulting three lights on his instrument panel whose flashes signal his position (a device invented by Metcalf) keep to his gliding course

Here, radio engineers believe, science has developed a radio searchlight, which opens the way to greater safety not only in the air, but also on the sea By throwing the beam in any desired direction, many useful things can be done

Other possibilities lie in new directions The klystron's ability to produce short waves may make it possible for a million people to talk simultaneously through a single circuit Operating on very high frequencies, hundreds of television channels can broadcast pictures and sound, where today one channel is available Surging electrons, breaking like waves on a beach, have opened many fields which engineers will conquer as time goes on

THE PITTSBURGH OF OLD PALESTINE

American Archeological Excavations at an Arm of the Red Sea Bring to Light a Buried City with a Smelter in which King Solomon Refined his Copper

By NELSON GLUECK
Director American School of Oriental Research Jerusalem

GREAT commercial enterprises were bound up in ancient times with the spices of Sheba and the gold of Ophir Solomon was the first—and the last—king in Jerusalem, who not only benefited from the overland trade route to Arabia, but also took full advantage of the sea route from Ezion-geber to Ophir

"King Solomon made a fleet of ships in Ezion-geber, which is beside Eloth on the shore of the Red Sea in the land of Edom Once in three years the fleet came in, bringing gold, silver, ivory, apes, peacocks a very great amount of sandalwood, and precious stones" (I Kings 9 26, *10* 22,11)

Enterprising entrepreneur that Solomon was, his shipping line evidently made such inroads in the lucrative caravan trade that had probably been largely in the hands of the Queen of Sheba, that she hastened to Jerusalem with all manner of presents in order to conclude an amicable trade agreement with him

"Now when the Queen of Sheba heard of the fame of Solomon she came to Jerusalem with a very great retinue, with camels bearing spices and very much gold and precious stones As soon as she came to Solomon she told him all that was on her mind, and Solomon answered all of her questions Then she gave the king one hundred and twenty talents of gold, and a very great quantity of spices and precious stones " (I Kings *10* 1,2,10)

A satisfactory commercial treaty was evidently negotiated between the two sovereigns, because we are informed that "King Solomon gave to the Queen of Sheba all that it pleased her to ask, besides what he gave her according to his royal bounty (I Kings *10* 13)

The pro Arabian policy of Solomon was all the more natural in view of the fact that along the eastern border of his kingdom lay great deposits of copper and iron They yielded the commodities he could exchange for the spices of Sheba and the gold of Ophir A long part of the trade route between Arabia and Palestine traversed this border stretch of land known today by its ancient name the Arabah It is a great rift extending between the southern end of the Dead Sea and the Gulf of Aqabah, as the northeastern arm of the Red Sea is now called It separates the territory of southern Transjordan from that of southern Palestine, and marked anciently the dividing line between Judah to the west and Edom to the east The archeological survey expeditions of the American Schools of Oriental Research Jerusalem and Baghdad, have mapped a long line of copper—and iron—mining and smelting sites in the Arabah, extending from near its north end all the way to the Gulf of Aqabah The presence of most of these sites was previously unknown They are marked by large slag heaps, the ruins of miners' huts and smelting furnaces, and great walled compounds in which the slave laborers were lodged and guarded. The pottery remains indicate indubitably that the period of main activity in these mining camps coincides with the reign of Solomon in the 10th Century B.C. These discoveries cast a new light on Deuteronomy 8 8 9, in which the Promised Land is described as "a land of olive oil and honey, a land where you may eat bread without scarceness lacking nothing, a land [in this instance the Arabah] whose stones are iron and out of whose hills you can dig copper "

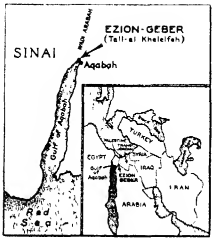
EXCAVATIONS conducted in the spring of 1938 and again in the spring of 1939 by the American School of Oriental Research Jerusalem, under the direction of the writer, at Tell el Kheleifeh near Aqabah, have resulted in uncovering part of the buried city of Ezion-geber, which served as King Solomon's naval base The location of Ezion geber was conditioned by a number of factors At first glance one wonders what induced the original builders to choose the particular site they did, because it is about the most uninviting one along the entire shore of the northern end of the Gulf of Aqabah Situated in the bottom of a curve which is banked on the east side by the hills of Edom which continue into Arabia and on the west side by the hills of Palestine which continue into Sinai, Ezion-geber is open to the full

The site of Ezion-geber, known today as Tell el-Kheleifeh, before the excavations began

fury of the winds and sandstorms from the north that blow down the center of the Arabah as if driven by a draft forced through a wind tunnel

The site of Ezion-geber is somewhat more than 500 yards removed from the gulf, and is about half way between Aqabah in Transjordan, and Mrashrash in Palestine. It is not difficult to understand why Ezion-geber could not have been built farther to the west From Mrashrash to the site of Ezion-geber, there is no sweet water obtainable in a distance of some three miles for drinking purposes The point where the sweet water wells begin is marked almost exactly by the location of the ruins of Ezion geber From there eastward, there is a continuous line of such wells, increasing in number the closer one gets to Aqabah, and marked by a correspondingly increasing number of date palm trees between the two points While one realizes, then, why the early builders of Ezion-geber could not very well have built farther to the west, one wonders at first why they did not build farther to the east, nearer to Aqabah, where there is more water and more protection from the winds and the sandstorms that blow fiercely and frequently, especially along the line of the location of Ezion-geber, in the center of the southern end of the Arabah. The actual excavations were to reveal that the founders of the city had considerable method in their madness, so to speak.

A section of the excavations at Ezion-geber showing ancient walls and modern workmen



Showing the precise location of the site of ancient Ezion-geber

The excavations were for various reasons begun at the northwest end of the mound, not the least of them being consideration for the direction of the winds. It was found that all the houses were made of mud brick. A large mud brick building with ten rooms was opened up, which occupied the entire northwest corner of the mound It soon became evident that this was not an ordinary large building or palace but a completely novel type of structure, the like of which had not previously been discovered in the entire ancient Near East The walls of the rooms were pierced with two rows of flues and the main walls were interconnected by a system of air channels inside the walls, into which the upper rows of flues opened The spaces between the two rows of flues had been turned green by reason of the sulfurous gases to which they had been exposed The originally unfired yellowish mud bricks had been baked by the heat of the fires in the rooms to the consistency of kiln-fired bricks Masses of hard baked clay debris on which the pottery crucibles had been placed, completed the picture

It became evident that the building was an elaborate refinery, where previously roasted ores were worked up into ingots of purer metal It was obvious both from the sulfuric discoloration of the walls, the fragments of raw ore found, and the numerous finished articles discovered in the site, that the refinery at Ezion-geber was devoted largely to copper, of which great quantities abound in the immediate vicinity and along most of the length of the Arabah, and in adjacent Sinai. A long period of mining and smelting and refining must have preceded the construction of the elaborate refinery at Ezion-geber The Kenites who were native to the country, and whose very name indicates that they were smiths, and the related Kenizzites who were also smiths by profession, were in all probability the ones who introduced the Israelites and the Edomites to the arts of mining and metallurgy It will be recalled that Moses took a wife from the Kenites, and that the Israelites ever afterward maintained the closest relationship with them The Edomites, too, were related to the Kenites through the Kenizzites The Bible tells us that Tubal Cain (a Kenite) was the first forger of copper and iron instruments and that the Kenizzites lived in the Valley of the Smiths which we take to be the Wadi Arabah with its long line of copper mining and smelting sites

EZION GEBER was thus more than a seaport It was primarily a great industrial center The second season's excavations revealed the presence of additional similar smelting and refining plants The reason, then, why the original builders of Ezion-geber chose the inclement site they did for the location of their city, was because they wanted the strong winds blowing from a known direction to furnish the draft for the furnace rooms in the refineries and to enable them to dispense with an expensive and burdensome bellows system It was a matter of harnessing the elements for industrial purposes More important to them than much water for fine palm groves, and protection from sandstorms in a location farther to the east, were strong winds which would enable them to operate without a hand-bellows system, the refinery with its intricate system of flues and air channels That Solomon built this great industrial and shipping center has been proved by the discovery of a very strong three-doored gateway, similar to the one he built at Megiddo, and almost exactly the same as the one built by him at Lachish

Solomon's copper and shipping interests, coupled with his rôle as im-

porter of spices and other precious products from Arabia, do not by any means exhaust the list of his major activities of commercial importance. As a result of all his immensely successful undertakings, the comparatively little kingdom he ruled over became a first-rate power among the nations in the ancient Near East. Its importance was altogether out of proportion to its size. Hardly had Solomon established himself firmly on the throne than he embarked upon a great system of public works which extended throughout the length and breadth of the land.

THE resplendent temple in Jerusalem was built, also a new palace, and fortifications for the city. Key fortresses were erected or strengthened throughout the country, store cities set up to preserve great supplies for emergencies, huge barracks to house his large standing army, and great stables for his chariots and the horses of his cavalry regiments, the figure of whose personnel is given as twelve thousand. Excavations at Megiddo have revealed the stables which were constructed there for Solomon, complete with rows of stalls and stone mangers and stone hitching posts. To carry out his building program, Solomon did not even hesitate to draft thousands of his own subjects into compulsory labor battalions. "And this is the reason of the levy which King Solomon raised, in order to build the House of the Lord, and his own palace, and Millo, and the wall of Jerusalem, and Hazor and Megiddo, and Gezer . . . And Solomon built . . . Beth-horon,

Sifting the debris to find the smallest objects it might contain

and Baalath, and Tadmor in the wilderness, and all the cities of store, and cities for his chariots, and cities for his horsemen. Solomon had forty thousand stalls of horses for his chariots, and twelve thousand horsemen." (I Kings 9:15-19; *4*:26; *5*:27-28)

All the stables which Solomon had constructed were not, however, intended solely for his army's horses. Solomon was in the literal sense of the word a horse trader. He was also a dealer in chariots. "And Solomon had horses brought out of Egypt, the king's traders receiving them at a price. A chariot could be imported from Egypt for six hundred and fifty shekels of silver, and a horse for a hundred and fifty. Thus through their means trade was carried on with all of the kings of the Hittites and the kings of the Aramaeans." (I Kings *10*:28-29).

It is understandable, then, in view of all of Solomon's industrial and commercial activities, that there was a remarkable economic development in Israel during his reign. He established himself as the great middleman for the overland trade between Egypt and Arabia on the one hand, and the Hittite and Aramaean kingdoms to the north of his territory on the other. For much of his imports he must have paid with the copper extracted from his mines in the Arabah and refined at Ezion-geber. There is indeed a basis in fact for the Biblical accounts about the fabulous wealth of Solomon. "The weight of gold that came to Solomon in a single year was six hundred and sixty six talents of gold, besides that which came from the traffic of the merchants and from all the kings of Arabia, and from the governors of the land. . . . The king made silver in Jerusalem as common as stone, and he made cedars as plentiful as the sycamore trees that are in the foot hills." (I Kings *10*:14-15, 27)

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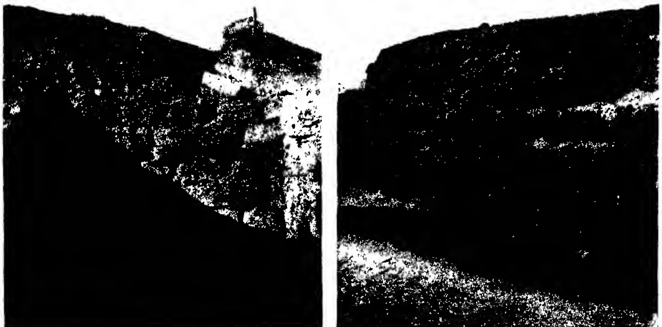
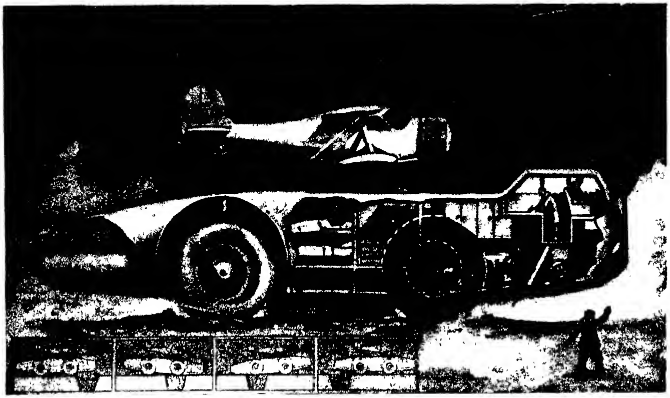
Though war has already limited the field excavations of the archeologists—the "digs," as they call them among themselves—this magazine will endeavor to present articles about significant digs if the war leaves one man to dig and one more to read. Fortunately, when war cramps the archeologist's work he still can work up material he has dug up while the digging was good and stored away.—The Editor



Inside and outside views of the south wall of the ancient copper refinery, showing the open ends of a number of the flues. The old mud bricks were found to have been fired to the hardness of kiln-fired bricks by the hot blasts of old



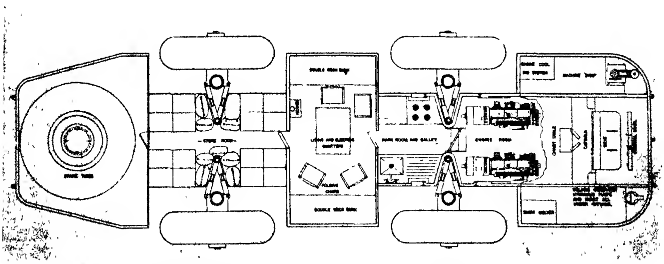
The monster Snow Cruiser which will go to the South Pole. Insets show Cruiser crossing a 15 foot crevasse. The front wheels are retracted, the body slides across, then rear wheels are retracted and front wheels lowered to driving position

The Snow Cruiser, A Mobile Base For Antarctica

WHEN the government-sponsored South Pole Expedition commanded by Admiral Byrd arrives in the Antarctic sometime this winter, it will have a unique vehicle which will be used as a mobile base. Designed by Dr Thomas C Poulter, it looks like a cross between a huge bus and a military tank. It is so constructed that it can negotiate rough ice fields, cross crevasses up to 15 feet wide, will make speeds up to 25 miles an hour, and have a cruising range of between 5000 and 6000 miles.

The craft will be 55 feet long and 15 feet wide, and will carry on its roof a five-passenger airplane. Its cost will be $150,000, its weight 75,000 pounds, and its body will be completely arc welded and so insulated that the crew may keep warm when the temperature outside is 100 degrees below zero. Inside will be a control room, engine room, galley, living quarters for four men, a store room and cargo space. The pneumatic tires will each weigh close to 1500 pounds. Hydraulic control of each axle permits the Snow Cruiser to "lift its own foot" so that a roof derrick may be used to change tires. A special device in each wheel keeps the air pressure constant by pumping in or releasing air as need be. The adjustable mounting of the wheels permits retraction of some wheels to allow the vehicle to slide over obstacles. Each wheel will be independently driven by a 75-horsepower motor, all being powered by two generators driven by two 150 horsepower Diesel engines.

The expedition will confirm the claim of the United States to a strip of land some 600 miles wide in the Antarctic and it is expected that the Snow Cruiser will drive straight to the South Pole and remain there for a number of months.



Illustrations courtesy The Lincoln Electric Company

Plan view of the unique vehicle which rolls or slides. Here are shown control cabin, chart room, bunks, galley, engines, store room. Note independent mounting of separately controlled wheels. Fuel tanks are along center line under floor

SCIENCE AND INDUSTRY

A MONTHLY DIGEST

Conducted by F. D. McHUGH

Contributing Editor
ALEXANDER KLEMIN
In charge, Daniel Guggenheim School of Aeronautics, New York University

VERSATILE EYE-TESTING MACHINE

MORE accurate and speedier eye examinations are made possible by the development of a remarkable eye testing instrument capable of placing an infinite number of different lens combinations before the eyes. In actual figures, the batteries of lenses contained in the device permit the amazing total of 61,060,386,816 different prescriptions, according to Dr. J. F. Neumueller, director of American Optical Company's bureau of visual science, who announced recently a new model of the instrument, far superior to the original developed a few years ago.

For many years prescriptions for glasses were arrived at by inserting different lens combinations into a spectacle frame held before the eyes. This was done by hand and the procedure to obtain an accurate prescription was slow, awkward, and often inaccurate.

In an attempt to speed up the eye examination and make it accurate, the Additive Phoroptor was developed. The instrument contains batteries of test lenses, by manipulating dials and knobs, different lens combinations can be placed before the eyes with astonishing rapidity. An ingenious mechanism within the instrument automatically adds the individual lens powers and records the total correction on an indicator. From this reading, glasses are then made up.

The design of the instrument's lens sys-

The Additive Phoroptor In Use

Rear view of the Phoroptor showing lenses used in the instrument

tem involved a mammoth task of mathematical computations, Dr. Neumueller stated, as not only the lens curvatures and thickness, and the distance between the lenses, but also the position of the lens system before the patient's eyes had to be controlled to assure the accuracy of prescriptions for glasses.

IMPROVED WHITE LEAD

IMPROVED manufacturing technique in the production of white lead has resulted in three interesting developments which are important to the paint user. The light-reflective quality of white lead has been increased from approximately 81 percent to about 90 percent and this results in an economy in the amount of artificial lighting necessary in the average home or office. Pure magnesium oxide, the whitest substance known and therefore the one used as a basis of comparison in photometric tests, reflects only about 7 percent more white light than does white lead. Light reflective qualities of paints which differ in their intensity by only a few degrees are not observable by the ordinary layman but, nevertheless, do bring about an appreciable economy.

Still another improvement due to the new manufacturing technique has been an increase of almost 23 percent in hiding, or covering, power which, while again not noticeable to any but the technician, does obviously create an advantage in making possible more economical painting, fewer gallons are required to cover a given area of surface.

A third development has been an increase in paint thickening properties, or bodying power, of white lead which decreases the tendency of the paint to run and sag during application and hence allows for greater brushing quality. — *C. F. Greeves-Carpenter.*

INSTRUMENT REGULATES LOCOMOTIVE CUT-OFF

LOCO Valve Pilot, developed by the Valve Pilot Corporation, is putting the theory of locomotive cut-off regulation into scientific practice. As steam engine science has long known, a certain quantity of steam, allowed to expand in its natural way, will accomplish the same result for the job at hand as a greater quantity of steam. The engineer's trick is to use the minimum amount necessary. This is referred to as cut-off, or fixing the steam supply to the

Location of the Loco Valve Pilot in the cab of a steam locomotive

cylinders at a certain point for maximum economy and efficiency.

To reach this goal, the Loco Valve Pilot is first a speedometer which functions in the usual way. On the same dial which shows speed, another pointer gives the correct cut-off for each variation in speed. Where, formerly, an engineer could only estimate his speed by counting mileposts or guessing, he now has an accurate speedometer. Then, instead of leaning out of his cab, listening to

the puffing sound from the smokestack and approximating the cut-off accordingly, he gets instantly and continuously all the necessary information from the instrument.

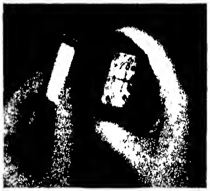
The device includes a recording instrument supplied with a roll of paper on which there is charted a record of the speed and cut-off during the entire trip. At the end of the run, the supervisor of operations has a written record showing how well the engineer handled his engine, so that economies in fuel and time may be calculated.

The motion of the locomotive is used as power for working the instrument. The speedometer mechanism consists of a speed unit drive fitted on the engine in frictional contact with the tread of a driver wheel. From this point, a flexible chain shaft leads to a centrifugal governor which actuates the speed-indicating needle and recording pencil. The power for moving the tape is taken also from the flexible chain drive.

The cut-off device is based on the principle of converting the motion of the reverse shaft into cut off. This is done by connecting the reverse shaft to a cam mechanism by means of a cam operating rod. This action is converted into cut-off in a cam box. Finally, a cable running from the box transmits the force to the cut-off hand and recording pencil in the cab.

Germicidal Energy Meter

Development of an easy and inexpensive way to measure the bacteria killing effectiveness of ultra violet from



Light meter attachment makes possible measurement of ultra-violet

germicidal lamps, has just been announced by Lighting Research Laboratory of General Electric's lamp department.

Conceived by Matthew Luckiesh, world famous scientist and director of Lighting Research Laboratory and Contributing Editor to Scientific American, the method of measuring the germicidal ultra-violet makes use of the familiar G-E light meter.

Over the sensitive cell of the familiar light meter there is placed a contrivance consisting of an appropriate fluorescing material sandwiched between a plate of clear quartz and one of clear ordinary glass. When the quartz side of the device is toward the source of germicidal energy, the fluorescence is excited by both the germicidal energy and the energy of longer wavelengths. Light emitted by the fluorescing material is measured by the light meter. When the glass side is toward the source, the short-wave germicidal energy is absorbed and, therefore, does not excite fluorescence. The energy of longer wavelengths does excite fluorescence. Obviously, the difference between the light meter readings serves as an accurate measure of the germicidal energy.

Elastic "Glass"

With the appearance of glass, with flexibility and elasticity, with resistance to water, perspiration, alcohol, and many oils and solvents, a new material just announced may find many uses in everyday life and in industry. In its natural color it is clearly transparent, but may be made also in rich and sparkling colors such as garnet, sapphire, emerald, amber, as well as black and white. So far, no hint of the chemicals comprising this material nor of the process by which it is made have been released for publication.

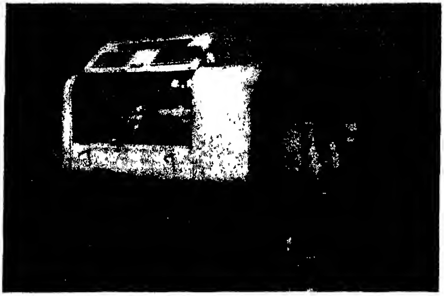
At the present time this elastic "glass" is being used for making garters, belts, and braces, but the manufacturers claim that it will soon go into the manufacture of luggage, handbags, women's belts, and many other similar items. Since it is quite tough, does not scuff or crack, is odorless, tasteless, and non toxic, it probably will be adapted to the manufacture of many novelties, and one may even expect to find it as a book binding, for it may be stamped in gold or in silver and will take printing.

BATTLE WAGONS

The United States has five battleships about the same age and the same general type as Britain's *Royal Oak*, which was sunk by torpedoes. They are the *Nevada*, *Oklahoma*, *New York*, *Texas*, and *Arkansas*.

Portable Air Compressor

Contractors often need compressed air for small jobs of breaking concrete or rock drilling, even though their work is not generally of a type that would permit them to maintain large and expensive compressors. On jobs requiring but little air it is often necessary to move large and cumbersome equipment to the site of the work. The Sullivan Machinery Company has, therefore, designed a portable compressor, called Zeph Air, which is light in weight, unusually compact, and may be towed behind any passenger automobile or mounted on a light truck. It is rugged and powerful, and, the manufacturers claim, is more efficient in several respects than larger machines of older types. It is furnished in two models, one of which delivers air at the rate of 60 cubic feet per minute, and the other at the rate of 85.



Towed as a trailer, the portable air compressor goes to a job

Lintless Surgical Sponge

Surgeons find it necessary to use some sort of sponge frequently during all kinds of operations. Sea sponges cannot be used because sterilizing and boiling breaks them apart. Hence, gauze pads and cotton pledgets are generally used. Gauze and cotton are easily sterilized but loose fibers from the cotton are a constant source of danger. Lint left in the wound may retard healing or serve as a place for bacteria to lodge.

A new type of sponge, just announced by duPont, is made from cotton fibers converted chemically into a regenerated form of cellulose. It will absorb 20 times its weight in water, is free of lint, and can be sterilized by boiling or in an autoclave. One set has been used, sterilized, and re-used, over 80 times. They have been used for eye, tonsil, and mastoid surgery—all operations in which the use of ordinary cotton in any form is dangerous.

Protecting Windows in Bombing Raids

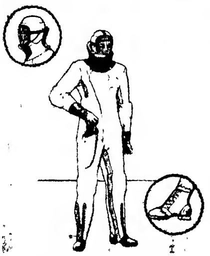
Safety glass, such as is used in motor cars today, depends upon the adherence of the glass to the glass's center layer of transparent plastic. This same principle (with variations) is being made use of, in European cities where bombing raids are imminent, to prevent flying splinters of glass when windows are broken by the concussion of exploding bombs.

Wire screen, cellulose sheets, and criss-cross gummed paper strips are being used

for this purpose. In addition, latex is either sprayed or painted on the glass. According to *India Rubber World*, "single sprayed coats of latex averaging 0.004 to 0.005 of an inch in thickness on ⅛ inch glass windows were found to prevent splintering when a two pound spherical weight was dropped on the protected glass from a distance of six feet, whereas unprotected glass shattered in all directions under the same force."

Fighting Forest Fires by Parachute

THERE were enough forest fires during the year 1938 to damage 33,815,000 acres (an area almost as large as that of the state of Arkansas) with damage estimated at about $37,000,000. Anything that can be done to reduce the number of forest fires or their effects is of national importance and the United States Forest Service is to



Special suit, head-gear, and shoes protect parachute jumper on landing

be complimented on its vision in utilizing the parachute as another protective method. Experimental use of the parachute is being made in the Chelan National Forest and, while definite conclusions have not yet been drawn, the experiments are highly promising.

One way of using the parachute consists of dropping fire-fighting tools, equipment and supplies needed by the fire fighter on the ground. One carefully planned kit comprises shovel, axe, flashlight, water, rations, compass, map, first aid equipment, and perhaps a light radio set. A simple 10 by 10 foot burlap 'chute is used.

Another method of utilizing the parachute is to drop the fire fighters themselves, after the equipment kit has been released. These men will be intensively trained and will be dropped on the "softest" spot as near the location of the fire as possible. Upon landing, the man crawls out of his protective suit, frees himself of the parachute, retrieves his equipment pack, and strikes out for the nearby fire. Two or three men may be dropped on the same spot, but one good "smoke chaser" can do wonders. The protective suit is shown in one of our illustrations. It is worn over the clothing, is padded with sponge rubber, and has a head gear fitted with a steel face mask and neck protector. There are ankle supports, tough gloves, reinforcing straps and other devices

Fire-fighters' supplies ready to be dropped by parachute to ground

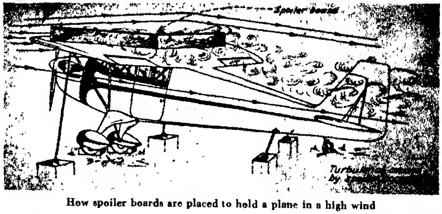
to protect vital spots of the body from injury. In a streamlined pocket, a rope is provided for climbing or descending from a tree.

Another item of interest lies in the parachute itself. The special 'chute meets Army and Navy requirements and descends at the relatively low rate of 14 feet a second. The new type of "lobe" 'chute is said to be safer than the more conventional type because it is built with an outside convex canopy resembling a collar 'round the rim, and is provided with flaps. By pulling down the shroud lines on either side and thus actuating the flap, the 'chute pilot can do a great deal to guide himself. Of course, it is quite possible to pull down on the shroud lines of the ordinary parachute not provided with flaps, but experienced jumpers consider such practice hazardous as it may cause collapse of the entire supporting surface. Another feature of the new design is the reduction of swinging to and fro of the jumper which lessens the chance of injury by striking trees or rocks.—*A. K.*

Tethering the Airplane

THE rapidly increasing number of private airplanes has resulted in a shortage of hangar space, and airplanes left outdoors can suffer real damage in strong winter winds. Walter C. Clayton, writing in *Aviation*, points out a number of methods of "tethering down" the airplane, whereby possibilities of damage may be reduced. The main principle is to reduce the lift of the wing.

One plan is to tether the plane in a substantially horizontal position, with the tail a little higher than in normal flight, and to head the plane into the wind. Another proposal is to tether the airplane with the tail into the wind, so that the lift forces will actually press the airplane onto the ground. A third method is that illustrated in the diagram. Here spoiler boards are placed over the wing. At the same time, the wheels should be carefully blocked, and various parts of the airplane fastened by cables to ground anchors.—*A. K.*



How spoiler boards are placed to hold a plane in a high wind

New Ideas for Aerial Warfare

JUST as in every war, a crop of new ideas have appeared to improve the gentle art of legalized murder. Since modern wars are likely to be fought mainly in the air, inventors and engineers have turned their attention mainly to devices which are concerned with aerial warfare. It is interesting to note a few such devices.

U. A. Sanabria, of the American Television Institute, has developed plans for a flying torpedo often suggested yet never practically realized. The torpedo is to be a small, streamlined airplane controlled by a larger airplane a hundred miles away. The torpedo plane is to carry a load of explosives which would explode on hitting the target. In the nose of the torpedo plane is a television transmitter which televises the scene in front of the torpedo plane to the distant control airplane. The personnel of the control ship is then able to steer the torpedo directly onto the target by radio control. Instead of subjecting costly bombers and well-trained personnel to anti-aircraft fire, enemy centers could be attacked by a cheap craft, with no risk to personnel. The question is: Can the multiplicity of complicated devices involved be made to work under actual and practical, rather than laboratory, conditions?

On the other hand, the Sperry Gyroscope Company is reported to be working on improvements to the more conventional bombing methods. In bombing operations today, the officer operating the bomb sight has to inform the pilot how to change the course so as to give him the best shot at the target. In a new electrical coordinating device, the bomber adjusts his sights, and an automatic pilot does the rest.

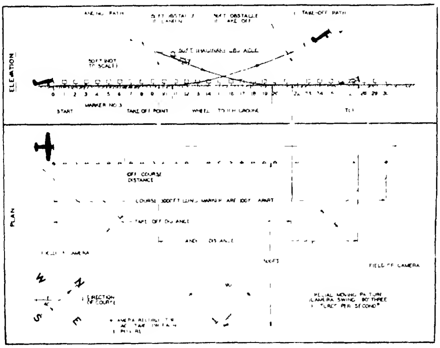
Incidentally, the accuracy of our present bomb sights is the envy of all foreign nations, and their construction is one of this

nation's most jealously guarded secrets. After practice bombings by the Air Corps, the sights are always removed and placed in safe-deposit vaults During recent months, reports have been current of direct hits on targets made with almost perfect regularity from altitudes of 25,000 feet -*A K*

Photographic Method of Measuring Take-off

IT is most desirable to know how an air plane makes a take-off or comes in over an obstacle, particularly when the wing loading is high The old theodolite system

Above Camera, at right, photographs plane during take-off, to check on flying ***efficiency*** ***Below*** ***Layout of the course on which such measurements are made***



of obtaining such information depends on the skill of the observer and leads to tedious calculations Photographic records with measurements made on films are more accurate, but cumbersome The Materiel Division of the Army Air Corps has therefore developed a new method which is accurate yet remarkably simple

The general scheme is illustrated in one of our diagrams The main piece of equipment is a "gun" camera, capable of taking three photographs per second, and provided with a built-in stop watch The only other equipment is an anemometer for measuring wind velocity, and large stand flags numbered from one to thirty Reports are made separately by the camera man, anemometer operator, course observer, and airplane pilot

It takes about an hour to get ready for the test As shown in the diagram, marker flags are placed at intervals of one-hundred feet on a 3000-foot course A portable camera shack is placed mid-way on the course but 1500 feet away from it. At a signal from the camera man, the test starts Continuous shots are taken from a point ahead of actual take-off to the point where the airplane has reached an altitude of over 50 feet In landings, the camera picks up the airplane at an altitude of nearly 65 feet and follows it until the wheels stop rolling. From start to finish of each test the stop watch automatically makes a time-record on each exposure.

After the strip film has been developed, it is wound on a spool and projected vertically on chart cards For this projection, the 3000 foot course is reduced to a scale drawing The chart shows directly, without calculations, the actual horizontal and vertical position of the airplane at any instant

A great advantage of this simple method is that the records can be studied at leisure by pilots and technicians, and the true ground performance of the airplane really evaluated Particularly when accepting expensive new airplanes, the Materiel Division will have a powerful weapon for check ing the predicted and contracted performance Of course, similar information is highly desirable also for private planes Certainly the buyer of a private airplane likes to know how long a run is required to clear such an obstacle as a hangar or a clump of trees situated near a landing field —*A K*

Rotary Aircraft Notes

A SMALL helicopter, being built by Dr De Bothezat, is to weigh something in the neighborhood of 600 pounds, with a 90 horsepower air-cooled engine. The aircraft is to be provided with two superimposed airscrews, each of the controllable pitch type The blades are to be of duralumin, besides vertical ascent and descent, a high rate of forward speed is expected Technical details are scarce and forthcoming flights will be awaited with great interest

An interesting thought from a correspondent While experimentation in very advanced 'giro and helicopter types is entirely in order, should not other manufacturers besides the Kellett Autogiro Corporation give a little attention to getting rotary aircraft into actual production, contenting themselves with evolutionary rather than revolutionary improvement?—*A K*

Why the Curtiss Hawk is Beating the Messerschmidt

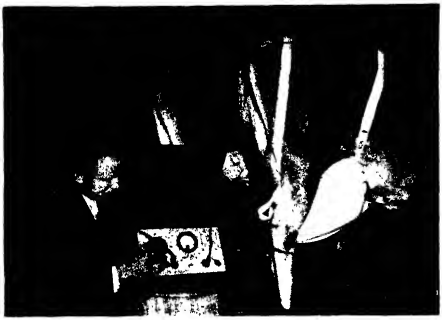
OF COURSE we are all neutral, but how pleasant it is to hear that the Curtiss Hawks are out maneuvering and out-fighting the German Messerschmidt pursuits on the Western Front! So many friends have asked us the reason that, after verification in well informed quarters, we can risk the following Maneuverability is to some extent a question of wing loading When the wing loading is too heavy, the ship can no longer be rapidly maneuvered, and in a sharp turn the plane may stall In the Messerschmidt, in the frantic attempt to secure high speed, the wings were given too high a loading, clipped too short It is, of course, too much to hope that German designers will not profit by the lesson! *A K*

RADIUM

AVIATION is creating an increased demand for radium salts for use on luminous instrument dials During the World War planes had a maximum of eight dials whereas today the average small plane has 12 to 15 luminous dials, and larger craft may have 60 to 75

Molded Non-Metallic Bearings

TO make molded non-metallic bearings to meet various service requirements, more than 30 formulas have been developed by the Gatke Corporation These bearings are now used in many industries as they have enormous resistance to wear, a lower



Cows are receiving the benefit of advances in medical science, as witnessed by this demonstration of a newly invented diathermy machine for applying heat treatment for adhesions and other ills of the udders of cattle. Demonstration was given by Dr E. D Hildreth, professor of bacteriology at Ohio University, at Randleigh Farm, Lockport, New York

coefficient of friction than metal, and are not damaged by salt water, oil, grease, or most organic solvents They have a high impact strength and will withstand repeated shocks and blows without being permanently deformed They are made in three general types water lubricated, oil or grease lubricated, and self-lubricating

Depending upon the formula, these bearings may be used in many industries, including the chemical, where they must be run continually submerged in various kinds of liquids

Drug Combats Serious Dog Disease

A NEW drug to combat the rapidly spreading heartworm infestation of dogs will shortly be made available to veterinarians The drug, antimonial III catechol thiosalicylic acid sodium, is the result of three years of intensive research by James A Austin and Dr Harold P Brown of Kansas City, Missouri

Heartworm infestation of the dog is a unique disease because living adult worms, *Dirofilaria immitis*, 8 to 12 inches long, situate themselves in the right heart Under treatment, the adult worms are slowly killed by gradually building up a concentration of trivalent antimony in the blood stream of the dog

The ill effect of heartworm infestation upon the host is not entirely due to the presence of the adult worms in the heart Larvae liberated into the blood stream also damage the dog These larvae, or microfilariae, 0 2 to 0 3 millimeters in length, are worm like in appearance, and move through the blood with a whipping motion

Heartworm infestation cannot be transmitted directly from dog to dog, but must pass through an intermediate host The mosquito has been indicted, and the tick, flea, and other biting and sucking arthropods and insects are suspected

Treatment of the condition involves a series of graduated daily doses of the drug administered intravenously —*Science Service*

Collision Switch

THOUGH fires seldom follow automobile collisions, the danger is an ever-present one and a menace not only to the lives of passengers but to the cargoes of large trucks When fires do happen they are usually

Above Collision switch in operating position When the car is in collision, switch opens the ignition circuit, as shown at the right

caused by the automobile's ignition which cannot be turned off as can that of an airplane when a pilot foresees a crash Thus the Grigsby Collision Switch has been designed to give a positive cut off of the ignition of cars and trucks as soon as a collision occurs

As shown in the two accompanying illustrations, this device is relatively simple A vertical weight rests upon a button which presses a disk in contact with two plates to complete the electrical circuit This weight is held in place by a spring so that ordinary jars and jolts have no effect upon the setting As soon as a crash occurs, however, the excessive jar throws the weight off the button so that the disk is sprung away from the plates, thus breaking the circuit completely By means of a protruding knob, the device may be reset instantly by the driver

Antiseptic Rubber

ANTISEPTIC rubber goods — dress shields, toys, baby pants—may soon be extended to include antiseptic rubber sheetings, surgeons' gloves, rubber cases for instruments and similar items, by the introduction of three new chemical compounds designed to render rubber fully antiseptic, according to a manufacturer

The new materials are reported to be three, three, and six times as powerful as thymol in antiseptic qualities They are white, odorless crystals, said to be effective in concentrations of 0 5 to 1 5 percent (depending on the rubber stock), and to contain no metallic salts

Rubber products so treated are said to meet with the standard tests for antiseptics as set forth by the Food and Drug Administration

Self-Registering Rainfall Measurer

AN instrument for measuring rainfall, invented by an employee of the Stockholm Observatory, Fabian Nilsson, has found widespread use in Sweden Readily portable, it works according to a new principle and is said to be ten times more sensitive than older apparatus of this kind In addition, it is capable of registering unlimited quantities of rainfall

The rain is collected in a moveable measuring vessel, which is automatically emptied in 1/50 of a second, whereupon it immediately functions again The instrument is self registering and works for a week at a time, and thus requires very little attention By means of an ingenious system, the rainfall is registered on a diagram paper from which can be read exactly the amount of rain which has fallen during any day, hour, minute, and even second during the week

The instrument measures snow with the same accuracy This is allowed to fall into a calcium chloride solution, which keeps the snow liquid even in very cold weather The

snowfall increases the volume of the calcium chloride, and the excess runs through a siphon device to a gage where it is registered *Holger Lundbergh*

Table Lamp Glows at Night

A UNIQUE table lamp, which becomes a glowing sphere when room lights are out, has been developed for use in bedrooms to eliminate groping for the lamp, and in nurseries to reassure children who are afraid of the dark The warm orange-red

Operating cost one cent a month

glow is not bright enough to keep light sleepers awake, yet it may easily be seen from any point in an unlighted room A tiny neon glow tube is concealed in the base of the lamp As soon as the room becomes dark, the soft, warm light characteristic of the neon glow tube emanates from the spherical body of the lamp, which is composed of translucent plastic The glow tube consumes only 1/4 watt of electricity operating cost of the tube being, therefore, less than 1 cent a month in spite of the fact that it burns continuously day and night

Astronomical Light Finders

DIE-CUT figures of luminous paint coated crescent moons, stars, comets, and some of the planets comprise a novel package recently put out under the name of Twinkle-Twinx Many people interested in astronomy are using these to locate light switches The backs are gummed so that they may be stuck to ceilings or walls where they may absorb the most light for activation The manufacturer claims that they glow for an hour after each activation

Spot-Welding the Retina

ELECTRICAL spot welding in the eye for restoring sight to patients threatened with blindness due to a detached retina is helping more than one out of three patients, Dr. Samuel J. Meyer, of Chicago, recently reported to the American College of Surgeons.

The retina is the light-sensitive part of the eye which transmits images to the brain through the optic nerve. It may be compared with the photographic film or plate in a camera It depends for its nourishment on tissue called the choroid When, because of injury or disease, it becomes detached from the choroid, it cannot function properly and the patient feels as if a curtain were falling over part of his eyes If not treated, the retina as a rule will eventually all peel away from the choroid, like wallpaper off a wall, and total blindness results

Modern eye surgeons treat this condition by a kind of electrical spot welding Tiny needles carrying an electric current are applied to the choroid without puncturing it The electric cauterization produces an adhesive inflammation between the choroid and the retina, causing the retina to become reattached

This method is only 11 years old, but eye surgeons are getting increasingly good results with it, Dr Meyer's report shows More than one out of three patients operated on at the Illinois Eye and Ear Infirmary since 1934 had re attached retinas with vision ranging from normal to one tenth normal *Science Service*

Heat Treating Cylinders

A NEW method of heat treating metals by electrical induction, which makes possible hardening of inside diameters of cylinders and other bores, has been developed by Budd Induction Heating, Inc

The process, which already is being utilized in production work at the Budd Detroit plant makes possible the heat treatment of inside diameters of metal cylinders from two inches in diameter up, and up to 50 feet in length

The area treated, depth of treatment, and

An automobile hub in the induction heat treatment machine described

the degree of hardness developed are controlled within exceedingly close limits, while timing of the operation is a matter of seconds

In hardening inside diameters in which the treated area is of considerable length, such as engine cylinders, a retracting type head, which heats the material by electrical induction, is used This is drawn evenly through the cylinder, followed by a water quench.

It is anticipated that the process will find wide use in the metal industry Other practical applications where it can be used to advantage according to metallurgists who have observed the process, are the cylinder bores of Diesel, gasoline, and steam engines, oil well casings, and the inside diameters of the sleeves which are the vital parts of all types of sleeve valve internal combustion engines

Courtesy Max Factor Jr

Grotesque? Yes, but even the glamor girls of Broadway and Hollywood have to don make-up such as this before they face the television camera Otherwise, they will not appear natural on the screen of the television receiver. Basic foundation is light tan, with solid white high lights below eyes on neck and throat hollows, laugh lines, and inside both nostrils Soft blue powder on the cheeks and dark red lipstick, with a definite undertone of blue, completes the working make-up for television

Germany's "Fat Gap"

ONE of the most conspicuous deficiencies in the German economy when Hitler came into power was the so called "fat gap" —the lack of sufficient supplies of fats of all kinds according to Karl Brandt, distinguished German economist now on the staff of the Food Research Institute of Stanford University To close this gap, the Germans expanded their dairy industry and improved the stock and all equipment Production of oil seeds was subsidized, while consumption of margarine, made from imported vegetable and whale oils, was discouraged Between 1931 and 1936, a 10 percent increase in pork production was achieved by encouraging the German farmer to fatten his hogs

In addition to these steps, many substitutes for fats have been suggested Sugar, jam, and marmalade have replaced to some extent butter and margarine Largely for this reason the German orchard acreage doubled between 1931 and 1936 Sugar has also been substituted for fats in baking The soap industry, which is the principal industrial consumer of fats, to a certain extent now uses coal and lignite derivatives as substitutes for fat in soap manufacture.

Fatless washing powders and synthetic cleansers are now commonplaces In paint manufacture, cellulose products now replace oils for some kinds of paint, and the use of stainless steel has been encouraged to cut down paint consumption

25-Million-Candlepower Searchlight

USING three of the small capillary water cooled mercury lamps described in these pages some months ago instead of the customary carbon arc, General Electric has developed a new 25 million candlepower

The small object held in the hand is the complete light-source unit of the 25-million-candlepower searchlight shown in the background

searchlight As there are no carbons to be replaced or adjusted, the new searchlight will function automatically The three high pressure mercury lamps, each rated at 1000 watts and no larger than a cigarette in size, are mounted close together Despite the enormous candlepower produced, little heat is generated, and 70 percent of this is removed by pumping 90 gallons of water an hour through the cooling jackets of the lamps

Fire-Trench Digger Does Work of Many Men

THE United States Forest Service has made important advances in scientific fire fighting this year They center mainly about such modern devices as airplanes and high-powered chemicals But the average man on the fire line is likely to name as the most outstanding recent development a contrivance called, after its inventor, a Bosworth trencher

In fighting forest fires the machine is used to dig a flat trench or ditch in advance of a fire or to turn the flank of the flames This trench is at least a foot wide and deep enough to remove all leaf mold or other inflammable material Along this line the fire fighters form to start a backfire or to put out small fires that may jump the trench

The new trencher, devised by Jim Bosworth, assistant supervisor on the Kaniksu National Forest in Idaho, and perfected after much experiment and suggestion, will dig 50 or more feet of trench a minute, depending upon the terrain and the strength and skill of the operators, and may do the work of as many as 300 men It has a wheel harrow type of frame with a heavy bicycle wheel to carry the load A small two-cylinder engine with a power shaft reaching groundward is suspended between the handles and drives a series of iron bars or "hammers" that swing from a central hub and throw the soil to one side

The trencher weighs 96 pounds A harness of web straps enables the man who pushes it to carry part of the weight on his shoulders In favorable country one man can push the trencher with good effect, but a towing bracket is provided so that one or more can aid by pulling where the terrain is tough

Generally one man goes ahead to clear a path, tossing aside fallen logs and loose rock and other encumbrances The machine can be disassembled and carried in a pick up truck or on a man's back in emergencies

Car Dumper Empties a Car a Minute

A NEW car dumper recently built for the Pennsylvania Railroad by Heyl & Patterson, Inc, is capable of emptying 60 cars an hour The dumper is located at Sandusky, Ohio, where it is an example of the most modern methods of coal handling A lift-and turn over type, the car dumper is built to handle 120 ton cars at a rate of 45 per hour or 90 ton cars at a rate of a car a minute The electrical equipment, supplied by the General Electric Company, is conservatively designed to handle the full capacity of the dumper on a continuous basis and is so flexibly arranged that the dumper can still handle the maximum load even though a major piece of electrical equipment should fail

"Leaded" Steel

"LEADED" steel is the newest trick of industry to increase the machinability of its product and thus bring lower production costs But not to be overlooked in the gathering wartime tempo of the nation's industry is the thought that "leaded" steel can increase the production of machine parts that are used in a thousand ways in everything from automobiles and airplanes to tanks and tractors Metallurgists F J. Robbins and G R Caskey of Bliss and Laughlin, Inc., reported these facts recently

The addition of small amounts of the soft, malleable metal to batches of steel makes "leaded" steel The result is a metal that can be cut faster on the lathes, gearing, and cutting and milling machines of industry There is less wear in cutting tools and dies, faster production, and fewer breakdowns in streamlined mass production operations All these factors in peacetime mean lower costs that can be translated into a cheaper product, or into increased dividends as the manufacturer chooses In war it means more machine parts for a war geared industry And metallurgists Robbins and Caskey showed that the strength remains unchanged while the machining properties are increased - *Science Service*

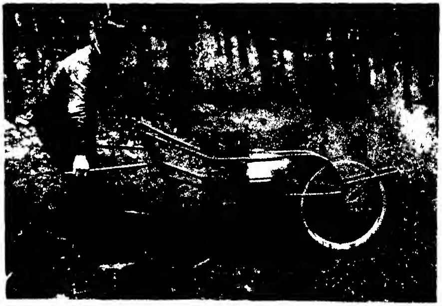
Soy Beans

THE 1939 acreage planted to soy beans totaled 8,119,000 as compared with the 1938 area of 6,058,000 and the 1928-37 average of 4,246,000. Illinois is the largest soy-bean producing state, with 2,452,000 acres under cultivation

Dam-Sealing Clay

LEAKS in ponds, dams, ditches, canals, and the like, may be effectively stopped by the use of Akwaseal, a product of the Wyodak Chemical Company This material is claimed to be the highest type of colloidal clay known Wyoming Bentonite Mixed in varying proportions with soil and packed around the point of leakage, it swells when wet so that it closes the spaces between the particles of soil

At a fish hatchery in Marianna, Florida, Akwaseal was applied in the following manner The pond was drained, bottom disked, and Akwaseal applied to the bottom and sides of the rearing pond in the ratio of 100



Demonstrating the fire-trench digger described above

pounds to 500 square feet and worked into the top soil to a depth of 2½ inches and then rolled with a heavy roller The soil formation consisted of sand and clay, the result was a reduction of better than 60 percent of the former seepage.

New Optical Pyrometer

AN entirely new temperature measuring instrument—not a re-design of a previous model—the Leeds & Northrup optical pyrometer is now a potentiometer Calibrated, not in milliamperes, but directly in temperature degrees, it measures temperature more conveniently, and with greater accuracy It is the first industrial optical pyrometer to use the potentiometer method Light in weight, easily and rapidly operated, rugged in construction, it meets those requirements important to an industrial pyrometer, and is also amply accurate for laboratory use This instrument is used in the production of metals, ceramics, glass, and the like, as well as in the laboratory.

Using the new optical pyrometer

Inexpensive Fire-Detection System

INVALUABLE in the protection it affords both life and property, while simple and inexpensive, the Fyre-Scout fire detection system will appeal to the average household, shop, farm, or factory Manufactured by Technical Appliance Corp, it gives warning of a fire at its inception

The heart of the system is the detector head or super-sensitive thermostatic switch enclosed in a neat enameled housing, of compact dimensions This unit closes the circuit and keeps it closed when a dangerous temperature is reached in its vicinity All detector heads are wired in parallel and connected between a large fire gong and a power source—a six-volt dry battery or a bell-ringing transformer. The basic kit comprises gong, two detector heads, and 75 feet of heavy-duty twisted-pair wire Additional heads are available separately, for as extensive a system as may be required The installation is as simple as wiring a door bell

Parts of a simple fire-detection system that operates on six volts

The detector heads are located high up on wall or ceiling of potential danger spots in home or other building, such as near the furnace, in the basement, kitchen, barn, attic, and so on The gong is placed where it will be heard best

WOOD

THERE are at present well over 4500 uses for forest products such as fuel, shelter, posts, implement handles, and others which, like cellophane and rayon, bear no apparent trace of wood or forest origin These are discussed in a new bulletin published by the Forest Service, U. S. Department of Agriculture.

Grandma Was Right, at That!

GRANDMA'S favorite tonic of sulfur and molasses turns out to have had more scientific basis than she probably suspected Experiments just concluded at the Massachusetts Institute of Technology show that old-fashioned molasses is just about the best food known for treating nutritional anemia, the kind of anemia due to improper diet

Spinach as a source of iron was thoroughly debunked by the research conducted by Dr. Robert A Harris, Dr John W M Bunker, and L. Malcolm Mosher Whereas molasses has 6 1 parts of usable iron per 100,000 parts by weight, spinach has only 0 5 Beef liver has 5 6, oatmeal, 4 6, with apricots, eggs, and raisins following in that order The scientists computed usable iron, not total content, for only that iron which the body can use to manufacture hemoglobin is valuable

The trio also reported that recent medical studies indicate that nutritional anemia is far more prevalent than had been suspected More than 40 percent of infants have it and the figure for adult women is as high as 70 percent It is also fairly widespread among growing children.—*Science Service.*

A Finer Porcelain Clay

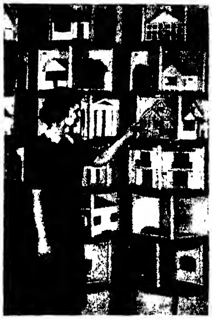
PORCELAIN enamelers have depended largely on Vallendar Clay, which is a German product, because of the fineness of that material Recently, however, the Porcelain Enamel & Manufacturing Company developed a new clay for porcelain which has been tested in plants throughout the country with highly satisfactory results Ordinarily, Vallendar Clay passes through a 250 mesh screen whereas the new "Pemco Micronized Clay" is so fine that it could pass through a 2500-mesh screen

This new clay is mined in North America and then prepared by the Micronizer process In this process the unrefined clay enters a cylindrical chamber at a speed in excess of 700 miles per hour, causing the clay to bombard itself This bombardment results in the explosion of the clay particles and their reduction to an average grain size of three microns (Three microns equals 0 00011811 of an inch) The terrific speed of this process causes the impurities -iron pyrites, wood, and the like—to be thrown out so that the result is a perfectly pure clay

Paint Combinations

THE Glidden Company has taken advantage of the fact that an animated sales display will attract more attention than one that is still, and in doing so have evolved a unique display for their paints More important, they have provided the prospective user of paints with the best possible manner of finding proper color combinations for both interiors and exteriors of homes

This display consists of a columnar collection of attractive, painted miniature home models which rotates upon a stationary base



Color schemes on display

Vertically the device is broken into a number of sections, each of which is divided into small angular spaces As these sections of the column revolve, the paint buyer will note a large number of color combinations presented in an attractive exhibit

Protection With Charcoal

CHARRING, probably the oldest method of preserving wood that is known to man, led to the development of a formula by Carbon Chemical Products, Inc, with which it is possible to "char" almost any kind of material including metal, concrete,

and asbestos without the use of fire The process does a double job of preserving and waterproofing materials

This new product is applied easily with a brush or spray, is non poisonous and non explosive, and will not burn the hands It is resistant to fire and most common acids, as well as to the depredations of termites After the product, which is named Kar Bon-Seal, has been applied it forms a hard, permanently bonded, non porous, flat black coating A gloss can be produced, and paints can be used over this chemical treatment

The base of the product is charcoal obtained by burning hard wood at 800 degrees, Fahrenheit The finished product has about the same consistency and coverage as paint

The same company also makes another product named Kar Bon Sealuminum which has all the properties of the former but dries to a silvery finish and also serves as a heat reflector for roof work

Germs Tell When Glasses Are Dirty

WOMEN have a different kind of germs on their rouged lips than men do, Drs L A Dick and G J Hucker, of the New York State Agricultural Experiment Station, recently reported to the American Public Health Association The germs are two varieties of *Streptococcus salivarius* and they were found on the rims of glasses in taverns, restaurants, cocktail lounges, and soda fountains

These germs, harmless in themselves, can be used as an index of how well such glasses are washed between drinks and of how many more dangerous germs may be left on the glasses by careless washing Nearly every presumably clean glass in a taproom will show these harmless germs as evidence of contamination and improper washing But of all the glasses examined, those in soda fountains were least germy *Science Service*

Simplified Push-Button Tuning

THE latest advance in push button radio receivers makes them as easy to adjust as roller skates It enables any radio set owner to change over the tuned circuits of his receiver with a minimum of effort and in a single operation This development is incorporated in the new Crosley push button sets in which there are hinged flaps which flip back to expose the adjusting screw or key for each button To reset a button for

Lifting one of the flaps to re-tune a new push-button radio receiver

a new station, the flap is lifted, a screw driver is inserted in the adjusting screw, and the key is pushed down as far as possible The key is then turned until the dial reading is that desired, the hinged flap is flipped back over the key, and the button is set for reception

Athletes Have "Fever" Temperatures

ATHLETES in severe muscular exercise can show body temperatures that normally would mean high fevers, according to Dr Eugene F DuBois of the Russell Sage Institute of Pathology, Cornell University Medical School Dr DuBois, reviewing studies of the body's temperature, showed that the familiar 98 6 degrees, Fahrenheit, which the clinical thermometer registers normally, is only one single spot between internal temperature and skin temperatures of 93 2 and lower —*Science Service*

Smallest Metal Tube Ever Produced

A PURE nickel tube with a hole so small that a strand of human hair could not pass through it is believed to be the smallest

World's smallest tube (left) compared with pin point (center) and hair (right), all 180 magnification

metal tube ever produced, it measures 26/10,000 of an inch in diameter The hole is about 1/3 this size and the thickness of the metal wall is about 7/10,000 of an inch

Pure nickel was used in preference to ordinary steel or other metal subject to rusting because even a slight speck of rust might clog the tiny hole

Gunk

A UNIQUE solvent that combines soap and water detergency with the high solvent performance of benzenes is announced by A F Curran, Research and Development Chemist for The Curran Corporation The new solvent, called Gunk, is, according to the development laboratory, sparkling clear in appearance, highly penetrating, and non-flammable

Small metal parts, stampings, extruded shapes, or die castings dipped in the solvent

The best protection the coffee bean has against loss of flavor due to evaporation of its aromatic oils is its own skin Hence the Kitchenaid container and electric coffee grinder The roasted beans are kept in the upper container and, at a flip of the switch a measured amount is ground as needed

assume a scoured appearance without etching, marking, or loss of weight Such parts may be rinsed by sluicing with water to obtain chemically clean surfaces where painting or lacquering is to follow It is said that where prevention of storage corrosion or rusting is desired, the parts need not be water rinsed, but are simply drained or centrifuged to remove excess solvent The light phenolic type film remaining will act as a rust preventive, making an extra treatment with oil unnecessary

Paint brushes no longer need be soaked in water or messy oil after using but may, instead, be dipped in Gunk This solvent not only dissolves the soft paint but emulsifies it as well so that the pigments and oil vehicle may be instantly and completely rinsed away under a water faucet as easily as you would wash soap from your hands

Advertising Goes Night Flying

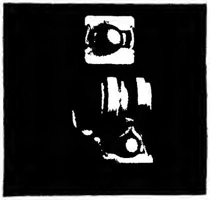
DURING favorable weather, the Goodyear Tire & Rubber Company maintains three dirigibles at their hangar at Bendix, New Jersey During daylight hours they provide an unique means of seeing the sights of New York City from the sky, but at night they carry over the city an ingenious neon advertising sign by means of which all sorts of messages may be flashed to observers on the ground

These neon signs are made up of 10 32-pound units, each four feet by six feet, on each side of the ship Interchangeable copy can be flashed on these frames from the control board in the gondola, which is connected by means of 330 circuits The signs are completely universal and the operator has a standard typewriter keyboard which, in turn, perforates a small paper tape This is then run through a "translator" If the message is to be repeated at regular

intervals, a complete loop is made of the tape so that it automatically repeats itself. Besides advertising copy, weather reports, correct time, air temperature, and news items of civic importance are flashed on the signs. While the ships are aloft they are in continuous two-way radio communication with the airport.

Double Felt Seal Bearings

SEALED ball bearings along entirely new and simple principles have been developed by SKF Industries, Inc. The seal used in these bearings is one that can be applied to bearings having a standard single row S. A. E. dimension of bore, inner and outer



Two felt seals and full-size balls feature this dirt-proof bearing

race width, which up to the present time has not been possible except through the use of small balls and, consequently, loss of bearing capacity.

This development has been made possible by departing from the conventional stuffing box type of seal in favor of modern air cleaner principles, sealing against dirt by the felt fiber contact on the polished surfaces of the inner race, and by the utilization of the natural tendency of deflected felt to resume its original flat shape.

Extensive tests have proved that the new seal retains the bearing lubricant and excludes any dust or dirt entry into the bearing itself, yet the sealing action is so light that the friction drag has been greatly reduced. The bearing is, therefore, suitable over a great range of speed.

Surgical Instrument Fishes Bullets From Abdomen

A NEW life-saving instrument that is attracting attention among surgeons is called a peritoneoscope, because in effect it gives the surgeon an eye at the end of his knife. It is a long, slender instrument, carrying a telescope and tiny electric light at its end and is equipped with a forceps for grasping a piece of bullet or clamping shut a bleeding artery. The instrument can be passed through the bullet wound or a stab wound made by a knife, saving the need of cutting open the abdomen, an operation which might prove fatal to a desperately sick man. Once the bleeding is stopped, the patient's condition may improve so that he can withstand an operation if necessary.

If there is no bullet wound, a needle is

used to make a hole through skin and muscles for the peritoneoscope to go through Air is first blown into the hole, to make a space between the tissues and internal organs, so that the instrument will not pierce these when inserted

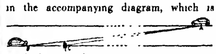
In the war on cancer, the instrument does its part by enabling surgeons to remove a bit of tissue for diagnosis With a needle instead of a forceps at its end, it may be used to drain a liver abscess The hole made by the instrument in such cases is so small it usually does not need even a stitch to hold it together while healing For this and diagnostic purposes, the patient is not only spared shock of an abdominal operation but need be in the hospital only 24 hours — *Science Service.*

ODD OPTICAL EFFECT IN MOTORING

RECENTLY a physician asked *The Journal of the American Medical Association* the following question "If you park by the roadside and watch the automobiles approach you on the opposite side of the road by means of a powerful field glass, you will find that any car approaching at 45 miles an hour appears, through the glasses, to be crawling along at about 10 miles an hour There seems to be some relation between time and space and our perceptive sense, and I am unable to get to the bottom of it."

That magazine answered with mathematics, which we simplify as follows

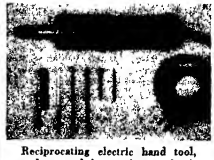
Assume that the observer is in car A in the accompanying diagram, which is



used through the courtesy of the above-mentioned *Journal* He views through 8-power binoculars car B, which, as the questioner said, is approaching at high speed Through the glasses the distance AB and, for that matter, any intermediate increment of that distant, will appear just exactly 1/8th the actual distance Thus when the car travels from B to C (or between any other two points) its rate of travel will appear to be considerably slower than is actually the case, simply because, in the same length of time it travels over a certain distance, it appears to be covering only 1/8th the actual distance Naturally, this explanation would apply only to cars coming head on.

ELECTRIC HAND CHIPPER AND FILER

RECENTLY placed on the market is a new electric tool similar to the small "hand-size" electric grinders but with the



Reciprocating electric hand tool, and some of the attachments for it

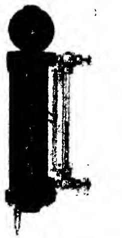
difference that the movement of the tool is reciprocating instead of rotating The handle containing the motor fits the hand nicely Into the chuck may be inserted small chisels for chipping, small files, honing stones, and even small hack saws Two models are made one with a 7/16-inch stroke, and the other with a 1/8-inch stroke The motor is 110 volt, for use on alternating or direct current

Neon Water Gage Illuminator

All who have squinted up at water gages on boilers will appreciate the neon illuminator for gage glasses being offered by the Wright Austin Company

This new neon illuminator is a surprisingly simple and efficient device, and consists of a neon light tube and a magnifying lens placed behind the gage glass

The liquid filled portion of the gage glass stands out as a broad, red neon band, and the empty space above fades into a hairline



Neon tube illuminates the gage

red stripe The water level can be read distinctly, day or night Neon rays penetrate not only darkness, but haze, steam, dust and fog almost as readily

The neon illuminator is furnished complete with a small transformer and an extension cord ready to plug into 110 to 120 volt, 60 cycle circuit It can also be supplied for a 25 cycle circuit, and also for 220 volts It is easily attached to almost any standard water gage by two U clamps, which grip around the top and bottom water gage fittings, and can be attached in a few minutes time.

Machine Wraps and Seals

Development of a Stretch-Wrap machine for packaging various articles of miscellaneous shapes in Pliofilm, is announced by The Goodyear Tire & Rubber Company. Known as the Pfeiffer Pliofilm Stretch-Wrap machine, it takes advantage of the following Pliofilm characteristics· stretchability when heated, strength increase in all directions when so stretched; extreme resistance to puncture when stretched, making application to irregular shapes easy; self-sealing when heated Thus with the new machine any article can be wrapped and sealed in one operation

The Stretch-Wrap machine should prove

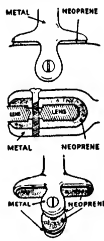
Irregularly shaped objects are rapidly sealed in this machine

advantageous to many industries now handicapped with a difficult or laborious wrapping or packaging operation Savings in material consumption is another decided advantage of the Stretch Wrap method Up to 300 percent savings in wrapping material can be effected For soap wrapping for example, a six by six-inch sheet of Pliofilm will wrap the same size cake of soap that now requires a 13 by 13 inch sheet with the wet wrap hand method

For many diverse small wrapping operations not sufficiently large in volume to afford an automatic machine operation, the Stretch Wrap machine should prove to be the ideal answer.

Vibration Dampener for Spectacles

HAVE you ever considered the installation of a vibration dampener on your spectacles? Probably not, but such a device might solve a problem for you, that is, if you are wearing rimless glasses and find that the



Three views of the vibration dampener that holds spectacle lenses

lenses break frequently, a cushion mounting between the straps and the lenses will aid in reducing breakage

In one design of this type a pad of neoprene completely surrounds the lenses, hold ing them in a firm yet flexible grip and protecting them from shock and strain The elimination of shock and strain also eliminates breakage caused by these conditions

At the top of our illustration is a side view of the strap and lens showing how the neoprene pad fits against the side of the lens In the center is shown the way the neoprene is carried over between the bole in the lens and the screw that presses the straps to-

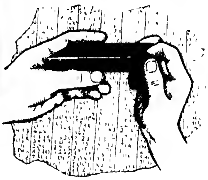
gether The bottom drawing illustrates the way the neoprene cushion mountings are arranged so that no metal will touch the lens

The advantages of this design are readily apparent and include the possibility of using stronger, more rigid straps around the lenses Neoprene is used for the pads because it provides a long lived mounting that will resist the effects of body acids and cleaning solutions But its ability to resist deterioration is not the only reason for its use

For example, if the strap contacts any material containing sulfur, the sulfur will cause discoloration of the gold surfaces and this discoloration might create the idea in the mind of the user that the straps were corroded Or, to clean up the discoloration, the user might employ a solvent which actually would cause corrosion So it is impractical to use any such materials for the mounting pad Fortunately, sulfur can be eliminated from the neoprene compound without adversely affecting the properties of the compound Such a compound will not discolor the straps, so the manufacturer is able to secure an efficient cushion mounting which will last for many years without endangering the life of the straps

Greasy Thumbs Have No Effect

TO any machinist who has had to thumb his way through a greasy data book looking for tapers or thread settings, the DataTule, a handy little vest pocket aluminum-cased file of information on things a



mechanic needs to know will be just what he needs A twist of the fingers brings a wealth of data and information into view Lard oil and grease have no effect on the legibility of the enclosed tables

A product of The DataTule Company, this two-ounce device can be readily fitted with any one of several printed strips of data It can also be threaded with a strip on which special data have been typed

Permanent Traffic Lane Markers

REPORTING in *The American City*, C W Paige, City Engineer of Alhambra, California, describes the construction of a double white centerline marker. The marker is of reinforced concrete placed to exact grade before the fine grading is done on the street This "curb" is 16 inches wide at the base, sloping uniformly to 12 inches at the surface, which is 10 inches above the base The top two inches of the marker is constructed with white cement. A two-inch deep groove is left in the center of this top section, three inches wide at the bottom and

four inches at the top. When the asphaltic surfacing is placed on the street, this groove is filled with the asphaltic material, leaving a smooth surface which is marked with a double centerline.

In *Public Safety*, Lieut R O Bennett, of the Lincoln Police Department, describes a method being used to install permanent lane markings in asphaltic streets already placed First, the pavement is softened with a burner, the width of the desired stripe. After this heating, a templet is placed on the surface and a coat of asphaltic emulsion is applied To this is added a half inch layer of white "Joplin Chats,"- flint-like stones The templet is then removed and a hand roller which develops over 300 pounds per square inch pressure is used to force the stone into the pavement

Lieutenant Bennett reports that these lines, some of which are more than five years old, seem to have gotten whiter with age He also states that it is better than a painted line at night or when the streets are wet

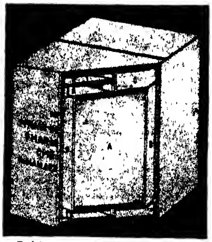
Refrigerator Carton

A NEW type of refrigerator carton to facilitate safe as well as speedy handling of serums, vaccines, and other perishable biological products has been developed by Container Corporation of America

The new carton, which allows the product to be packed with dry ice, was developed to meet the needs of Pitman Moore Company of Indianapolis and already has been placed in use in the shipping of animal vaccines

In this carton, biologicals can be shipped by express to any part of the United States at a constant temperature of from 32 to 42 degrees, Fahrenheit It carries a maximum of three pounds of dry ice, sufficient to maintain low temperature to destinations several thousand miles away

The dry ice is first wrapped in heavy Kraft paper and then placed in a bunker at the top of the carton shown in our illustration The product itself is carried in an

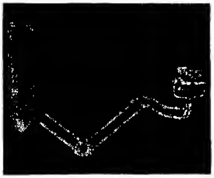


Refrigerator carton: A, storage. B, air space. C, dry ice bunker. D, pads

inner shell, with air space on all sides to allow circulation of the fumes from the dry ice. The inner carton is suspended by pads at the top, bottom, and corners

Wall-Mounted Dental X-ray Machine

INDUSTRY'S lightest structural metal finds a unique use in a new wall mounted, shock proof dental X-ray machine Weight has been reduced from one third to one half through the use of Dowmetal



According to H G Fischer & Company, one of the world's oldest and largest manufacturers of X-ray equipment, unprecedented standards in light weight and compactness characterize this new instrument The extension arms and mounting mechanism are designed to give exceptional compactness against the wall at the same time assuring full extension and flexibility for easy manipulation while the patient remains seated in the dental chair with unusual freedom from tubehead vibration

Document Protection

A SPECIAL light filtering yet transparent glass that retards aging of valuable documents and other articles protected by it, known as Hi-Test Laminated Document Glass, has been developed by the Pittsburgh Plate Glass Company This special glass essentially is a "double deck" sandwich in which three pieces of glass, each ¼ of an inch thick, form the "toast" and two thin sheets of vinyl plastic the "meat"

The two outer layers of glass are of clear plate glass, while the inner "toast" of the sandwich is a high lead-content plate glass that filters out the harmful rays The three pieces are held together with the vinyl plastic "meat" which makes them resistant to blows

Sandbags to Destroy Dunes

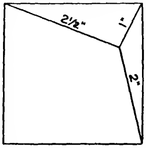
SANDBAGS are being used, says the United States Soil Conservation Service, to do a strange job. Laid across the crests of sand dunes, they are causing the dunes to disperse.

As long as a sand dune has a sharp upper crest, a prevailing wind will continue to build it up. Break that upper crest into a sawtooth form and the wind begins to tear it down. Some farmers in the west cut the crest lines of dunes by means of a disking machine or by pulling a pole drag along the crest. This process has to be repeated as the dune gets lower and gradually cuts a new, clean, crest line. Sandbags, however, follow

The Problem of the Square

CONTINUING our series of mathematical amusements, this month we have something a little different. If you have found some of the preceding problems a bit too difficult because calculus was required for their solutions, perhaps this will be more interesting.

Construct by graphical means, that is, using a compass and ruler, a square having



three corners at distances of 1, 2, and 2½ inches from a point within the square. Also, compute the length of a side of the square.

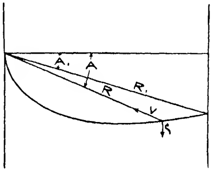
As usual, this problem comes from Lieutenant Commander Leonard Kaplan. All correspondence concerning it should be addressed to him in care of Scientific American, 24 West 40 Street, New York, N Y. We forward all letters unopened.

Solution to Our Problem of the Dog in the River

IN our December number was proposed a problem concerning a man and his dog. And here is the solution which was promised for this month. It was required, if you don't remember or if this is your first sight of the problem, to find out how long it takes the dog to swim the river which separates him from his master. The dog swims at a rate of two miles per hour, always headed toward the man, and starts from a spot 0.14 miles below a point directly opposite its master. The river is 0.48 miles wide and flows at one mile per hour.

The following symbols are used in our solution and sketch:

V, velocity of the dog, (2 m p h).
v, velocity of river, (1 m p. h).
t, time after starting, hours
R, distance in miles between man and dog at any time, t.
A, The angle made by R with a line normal to the bank of the river
A_1 and R_1, values of A and R when t is zero



Now, resolving the velocities V and v along R and at right angles to R, we have

$$\frac{dR}{dt} = v\sin A - V \quad \text{and} \quad \frac{dA}{dt} = \frac{v\cos A}{R}$$

Consider next the identity

$$v^2 - V^2 = (v\sin A - V)(v\sin A + V) + v^2\cos^2 A$$

and substitute in it the values obtained above for

$$v\sin A - V$$

and

$$v\cos A$$

Then,

$$v^2 - V^2 = (v\sin A + V)\frac{dR}{dt} + (v\cos A)\,R\frac{dA}{dt}$$

Integrating,

$$(v^2 - V^2)\,t = vR\sin A + VR + C$$

Setting $t = 0$ and solving for the constant,

$$0 = vR_1\sin A_1 + VR_1 + C$$

Hence,

$$(v^2 - V^2)\,t = R\,(v\sin A + V) - R_1\,(v\sin A_1 + V)$$

Substitution in this equation of the values given in the problem, ($v = 1$, $V = 2$, $R_1 = ½$, $\sin A_1 = 0.14/0.5 = 7/25$) gives the time required to cross the river. That is, when $R = 0$,

$$t = \frac{-\frac{1}{2}\left(\frac{7}{25} + 2\right)}{1 - 4}$$

giving a time of 0.38 hours or 22.8 minutes.

... the crest line down and presumably stick to their job until the entire dune has been leveled.

This method is being used where lands were denuded of sod and where dust storms were numerous in recent years.

No More "Burned Out" Cows?

"BURNED out" cows will no longer plague the American farmer. Chemists have found that a diet of corn sugar or molasses prevents ketosis, a disease which cuts milk production and inflicts economic loss, it was announced recently by C. F. Huffman and C. W. Duncan of the Michigan Agricultural Experiment Station.

Ketosis, it was explained, is characterized by the inability of animals to burn fat completely. "The incompletely burned fatty fragments are called ketone bodies. The term ketosis implies the abnormal accumulation of the ketone bodies in the blood and their excessive excretion in the urine.

"Their accumulation in the body of dairy cattle is of economic importance because they result in a drop in milk production, in a loss of appetite, and a decrease in body weight in the more pronounced cases. Ketosis is the modern name for the disturbance which was formerly referred to when the farmer said that his cow was 'burned out'."

Over-Inflation in Truck Tires

DURING the past several years there has been a gradual swing from high-pressure truck tires to balloons. Many truck owners, however, are not receiving full benefit from their balloon equipment because

they are continuing to use air pressures more in keeping with high-pressure inflation recommendations and not the pressures recommended for balloon tires

Over-inflation reduces deflection and contact area, causing the tire to ride on the crown This results in the following (1) tread wear more rapid than normal, (2) increased tendency toward bruise or crown breaks; (3) excessive strain on beads and rim, (4) abnormal growth and possible tread cracking, (5) more cuts and snags than would be experienced with proper inflation, (6) abnormal stresses and strains in the tread area which increase the tendency toward tread separation, (7) harder riding and increased up keep on equipment, (8) reduced non-skid qualities by reason of smaller area of road contact.

Among the recommendations for proper inflation are inflate to proper pressure when tires are cool, if tires are continually *under-loaded,* use air pressure to correspond with actual load carried (refer to a load and inflation table), if both load and speed are factors, either load or speed must be reduced to obtain normal service, never "bleed" tires to relieve "build up" of pressure caused by heat The ratio of temperature to pressure "build up" in service is approximately $8\frac{1}{2}$ degrees of temperature for every pound of "build up"—*India Rubber World,* from Bulletin No 13, Rubber Manufacturer's Association, Inc

Identifying 'Shakespeare'

(Continued from page 8)

one Joseph Hall who in 1748 was employed to repair and otherwise "beautify" the statuary The Oxfordian color scheme is also found in practically every one of the ancient paintings of Shakespeare that show him dressed as a nobleman

Exigencies of space prevent reproduction at this time of anything approaching a complete layout of the pictorial evidence gathered during our investigation of the three portraits The triple set of infra red and X ray studies alone total more than 20 plates I shall, however, try to give a general idea of results achieved by outlining briefly our dissective study of the "Ashbourne" painting (page 4)

First brought to public attention in 1847 by the Rev Clement U Kingston, one of the masters of Queen Elizabeth's Free Grammar School at Ashbourne, Derbyshire, this impressive work of art had long been in possession of one of the old British county families who treasured it as a genuine and contemporary portrait of Shakespeare Mr Kingston knew there could be no question of the picture's antiquity, for the canvas was in rags and had to be immediately re backed to preserve the painted image Abraham Wivell, a portrait painter of talent and one of the few recognized authorities on Shakespearean art, vouched for the "Ashbourne" as a composition of the late Renaissance and for its technical relationship to other ancient representations of the Bard Wivell's findings were corroborated by Samuel Timmins of the British Society of Antiquarians and also by M H Spielmann, Shakespearean art authority of the "Encyclopaedia Brittanica" About 11 years ago the portrait was brought to this country by the late Eustace Conway, who finally sold it to the Folger Shakespeare Library It is generally considered the most beautiful, as well as the largest, of all the many famous old portraits of the poet now owned by this $22,000,000 foundation It is life-size, three-quarter length, covering a canvas 47½ inches long by 37½ inches wide

Facing three quarters to the observer's right, precisely as Lord Oxford does in both his Portland and St Albans pictures (Figures 1 and 2), Shakespeare appears as a courtly gentleman of middle life, dressed in a black doublet and black bombasted trunk-hose with inserts of gray satin in the puffed pleats.

His waist is encircled by a rapier belt of French design, consisting of black leather and gold filigree work, while about his neck is a flimsy and skimpy ruff—entirely out of key with the rest of the attire

He stands by a square edged table, covered with a wine red cloth On the table, just beneath his right arm, appears a human skull or *memento mori,* the same emblem of mortality that Falstaff mentions in "I Henry IV" It is interesting to note that the top of the wall memorial to Shakespeare in the Stratford Church is crowned by an identical example (page 4) of the "Ashbourne" skull—both being minus the lower jaw

In his right hand Shakespeare holds a small, elegantly bound volume, tooled in gold and displaying open tie strings of sheer crimson silk Eustace Conway and other students of the portrait have opined that this is the poet's private copy of his "Sonnets" A masque of tragedy and crossed spears appears in the center of the cover They are raised above the surrounding surface and painted in a tone of orange gold quite different from the lemon gold of the rapier belt This indicates that the masque and spears, like the skimpy neck ruff, are later additions to the original composition

The inscription, AETATIS SVAE 47 A° 1611, in the upper corner of the canvas, to the observer's left, corresponds with the chronology of the Stratford man's life, but has been painted in the same tone as the ruff and the masque and spears, obviously at the same time M H Spielmann gave it as his opinion 35 years ago that all these additions are of ancient application We shall learn more about them in a moment or two, when we come to examine the dissective photographs

A gauntlet of the type that Elizabethan courtiers wore on dress occasions dangles from Shakespeare's left hand It is of rich maroon material, tasselled, and appliquéd with cloth-of gold tape A somewhat similar gauntlet will be observed on Lord Oxford's right hand in his portrait which bears the date 1575

Many have remarked on the length of Shakespeare's fingers, especially the left thumb, which bears a signet ring of the swivel pattern, the unmistakable mark of a dignitary Turning to the St Albans portrait of Lord Oxford (Figure 2), which was evidently painted by Marcus Gheeraedts the Younger when the Earl was about 36

years old, we find the same unusually long fingers and thumb Here they draw attention to the device of the wild boar, hanging around the nobleman's neck (See Figure 6) This boar served as the crest of the famous Vere family to which Oxford belonged It is one of the best-known devices in British armory

The matrix of the thumb seal that Shakespeare wears in his "Ashbourne" portrait (page 4 and Figure 7) is about the size of a present-day sixpence The original design is not apparent to the naked eye because the matrix has been treated to a daubing of the thick orange gold already mentioned

When we examine our semi microscopic close up of the seal, however, its hidden design takes form (Figure 11) Underlying shadows, plus broken surface brush strokes, give us the eye, the ears, the long snout, jaws, lolling tongue, and tusk socket of a wild boar- the same armorial device that Lord Oxford wears in his St Albans portrait!

We know quite definitely that Willm Shakspere did not have a signet of any pattern For at the conclusion of his will, which was signed at Stratford in February, 1616, when we come to the paragraph reading "whereof I have hereunto put my scale" the word "seale" has been struck out and the word "hand" (meaning handwritten name) substituted

In order to find out whether Lord Oxford might have possessed a signet ring, I wrote to the Librarian of Hatfield House in Hertfordshire, the ancient seat of the Cecil family with which Oxford was allied through his first marriage Two dozen or more personal letters from the Earl are still preserved here In due course, I received the following reply, dated February 17, 1939

> I have examined the correspondence of Edw de Vere, 17th Earl of Oxford, in our collection, and find that with one exception all the seals extant are wafer seals of the de Vere arms and show no distinguishable detail The remaining example - a small signet seal, the size of a sixpence—appears to represent the de Vere crest of a Wild Boar on a coronet, shown in its entirety This seal is a very poor specimen and not worth photographing . . I enclose a rubbing
>
> Yours faithfully,
> J. V LYLE.

From the rubbing of the wax impression which Mr Lyle was kind enough to enclose, it is immediately apparent that we have an example of the same swivel type of thumb signet that Shakespeare wears in the "Ashbourne" painting The artist merely confined his design of the matrix to the wild boar's head instead of meticulously reproducing the whole Vere crest

Our photographic dissections (Figures 4 and 9) of the "Ashbourne" head not only bring it into unquestionable conformity with the two inscribed Oxford portraits but show how this literary nobleman was long ago converted into a bald-headed counterpart of the synthetic commoner who appears in the stone memorial effigy at Stratford and in Martin Droeshout's clumsy engraving on the title-page of Shakespeare's First Folio

Reference to our infra-red plate (Figure 9) discloses that the original forehead has been raised an inch or more The crude strokes of the renovator's brush show the same slap-dash haste and the same technical deficiencies that are apparent in similar operations on the other two Shakespearean portraits that we have found to be disguised likenesses of the poet Earl

The hair in the "Ashbourne" has been re-done to match the synthetic forehead. That the head was originally topped by a normal growth seems evident. Oxford has a good red brown thatch in both the Portland and St Albans paintings.

The infra-red dissection of the neck-ruff is also revealing Undersurface outlines make it plain that this was once a huge circular affair, covering almost twice the area of the flimsy thing now on view, and that it was of the fluted pattern affected by many of the elder Elizabethan statesmen Of course a neck piece of this aristocratic design would be so strikingly inconsistent with Willm Shakspere's known position in life that it would be one of the first articles of personal adornment to be sacrificed by any one interested in converting a portrait of Lord Oxford into an alleged representation of the Stratford native

The present surface inscription on the "Ashbourne" canvas (page 4), although conforming to Shakspere's personal chronology, struck Spielmann as questionable when he first examined the portrait, which he describes as that of "a gentleman, perhaps a noble, born and bred" The Shakespearean art authority of the "Encyclopaedia Brittanica" made much of the hurried crudeness of the lettering, with cross-bars missing from the *A*'s and *E*'s, the poor spacing and lack of alinement It is also worth reiterating that the gold paint used for this lettering is of the same orange tone that appears in the raised daubs on the book cover and the disguised thumb ring

Our X ray photographs of the inscription area (Figure 13) reveal a whole series of clues which, taken together, seem to leave no loop hole for doubt regarding the true identity of the man in the painting

The first of these exposures—the upper half of the figure—makes it plain that the original inscription was something far different from the one which appears on the surface today And although this pristine lettering was long ago scraped out—so vigorously that perforations were made in the canvas -it is still possible to distinguish the ghostly remnants of both alphabetic characters and numerals

More exciting still, a phantom crest appears just below the inscription And beneath the crest, our second X-ray exposure has brought to light a full shield of arms, surrounded by decorative mantling and a scroll that evidently once bore a family motto. As a sort of appendage to the whole layout, the artist has added his monogram, identifiable as a conventionalized C K The entire section, containing this feast of evidence for scholars, genealogists, and art historians alike, was painted from view at some remote period, undoubtedly at the time the original inscription was destroyed It is even possible that these changes were made in the painting early in the 17th Century so that Lord Oxford in Shakespearean disguise could be used as "copy" by Garret Johnson, the London sculptor who made the memorial effigy of the Bard that was set up in the Church at Stratford

Let us see, meanwhile, what this evidence of the hidden arms and the artist's monogram has to tell us in summing up the case.

The recovered device on the upper part of Figure 13 is really a double crest. To the

left, the faint black penciling of a leopard or lion appears, while to the right is the white outline of a griffin.

Months of research have proved that two Elizabethan families of Staffordshire had crests that corresponded to the above combination They were the Sneyds of Keel Hall and the Trenthams of Rocester Abbey. About 1592, Edward de Vere Earl of Oxford, then known as the most gifted poet and brilliant writer of unpublished comedy at Elizabeth's Court, married Elizabeth Trentham, one of the Queen's Maids of Honor, for his second wife. Elizabeth Trentham's father was Thomas Trentham, of Rocester Abbey, High Sheriff of Staffordshire Her mother was Joan Sneyd Trentham, daughter of Sir William Sneyd of Keel Hall So the combination crest could designate the Countess of Oxford

The shield of arms, shown in the lower part of Figure 13, would seem to make this armorial identification positive, for the Trentham arms are described in contemporary records as *Three griffins' heads, erased, sable, beaked, gules* And the photographic reproduction (Figure 15) of the Trentham shield in stone, which was placed in St Peter's Church, Wolverhampton, some time during the 1580's, corresponds so closely to the phantom shield in our X ray picture that there seems no room for argument The dispositions of the three heads on both shields are identical, the only differences in detail being such as would be inevitable in comparing a finished work in stone with the shadow of a design in paint that has been long subjected to chemical amalgamation with concealing coats

But—it may be asked—how comes it that the literary Earl of Oxford would have his wife's arms, instead of his own, emblazoned on his portrait?

Genealogists tell us that it was a common custom in medieval days for knights to honor their ladies in this manner Richard Neville Earl of Warwick—the famous "Kingmaker"—is an outstanding example His great seal bears the crest of his wife, Anne Beauchamp, and his mother, Alice Montague, with no sign whatever of the Neville family arms.

Moreover, we find this statement in Franklin's "The Bearing of Coat Armour By Ladies" "When armoury was in the making, no arrangements were made for women to bear arms If the lady were an heiress, or owned lands, *her husband bore her arms for her*"

Upon her father's death in 1587, Elizabeth Trentham had inherited considerable property under the terms of his will

So it appears that, in having the double crest and shield of his heiress wife painted on his own portrait, Lord Oxford was merely following approved etiquette It is also probable that the painting was originally designed as a personal gift to the wife who brought the harassed nobleman respite from known financial straits, as well as a son and heir In this connection, it is significant that the painting takes its name from Ashbourne, Derbyshire, where Mr. Kingston first drew it to public attention early in the last century. The "Ashbourne Addition" in this same locality was one of the properties owned by Elizabeth Trentham Cockayne, great-grand-niece of the Countess of Oxford, who became sole heiress of both the Vere and Trentham estates about the middle of the 17th Century.

Our final piece of corroborative evidence in this classic example of mistaken identity is the artist's monogram distinguishable in our X-ray picture (Figure 13) The conventionalized initials, CK, when studied in close-up comparison (Figure 14, at left) with other authenticated monograms (same figure) of Cornelius Ketel, the great Dutch portrait painter who was born in 1548 and died in 1616, show conclusively that Ketel must have been the artist who signed the "Ashbourne" canvas in its original, undisguised state All other considerations aside, the discovery of Ketel as the creator of this portrait should enhance its value far beyond the sum which the Folger Shakespeare paid for it For the Dutch master is now recognized as one of the really great portrait painters of the late Renaissance, perhaps the most gifted forerunner of Rembrandt He made his home in England from 1573 to 1581, and during this period and later is known to have done the likenesses of many of the most distinguished members of the English and Scottish aristocracy, including Queen Elizabeth and King James

Moreover, when we turn to the contemporary account of Ketel's career, published in 1604 by his friend and fellow artist, Karel Van Mander, we find the following significant statement "*Ketel also made a portrait of the Duke of Oxford (Edward de Vere)*, the High Chancellor (Sir Christopher Hatton), and of many other important members of nobility, with their wives and children Some of these portraits were life size and full length"

George Vertue, the English art commentator of the 18th Century, also speaks of a large portrait of the 17th Earl of Oxford that had been painted by Cornelius Ketel Vertue was not able to trace the work at first hand, as it had quite evidently become completely confused with the Shakespearean arcana by the time he wrote But he remarks that it was once in possession of a Countess of Strafford

Henrietta Maria Stanley, great-grand daughter of Edward de Vere Earl of Oxford, married William Wentworth Earl of Strafford in 1655 She may have been the Countess of Strafford that Vertue mentions

In any event, we are able clearly to connect this remarkable "portrait of William Shakespeare" with the poetical Earl of Oxford and his heirs and descendants in so many ways that there should be no lingering doubt of the identity of the real man of letters beneath the over painted surface

My investigation to date convinces me that a whole series of portraits of this eccentric peer who had lost caste, political reputation, and wealth for reasons that historians associate with literary and dramatic extravagances, were long since converted into representations of "Shakespeare" The two likenesses known as the Portland and the St Albans pictures, which show Lord Oxford wearing head-coverings, could not be so easily disguised These bear his name and titles on their surfaces Such a situation should explain logically why eight or more antique paintings are listed by the "Encyclopaedia Brittanica" as traditional portraits of the hazel blue-eyed, auburn haired "Bard of Avon" which depict him in the apparel of a nobleman.

And, as the penetrative eye of modern photographic science is focused more sharply upon this extraordinary picture-puzzle, more and more evidence accumulates to argue that we have at last found a visual key to the age-old mystery of "William Shakespeare's" real personality.

YOUR FIREARMS

Conducted by A. D. RATHBONE, IV

INTEREST IN FIREARMS *is traditional with American men, science has so developed them that millions yearly find sport and recreation in their use. Hence this monthly department presenting a wide variety of discussion regarding firearms, their handling, and their accessories. Suggestions from readers will be heartily welcomed* —The Editor.

Shotgun Heresy?

WHEN, in 1807, Rev Alexander Forsyth, Scotch Minister, received an English patent for a firing lock which proved to be the basic principle underlying evolution of the metallic cartridge, breech loading, and other modern firearms improvements, British sportsmen readily accepted the Forsyth detonating theory, but 30 years passed before the English army officially adopted the percussion method in favor of their old "Brown Bess" flintlock muskets. The army said the Forsyth idea was "objectionable and dangerous."

When, recently, the W R Weaver Company announced a new one-power (no magnification) 'scope for shotgun use in skeet, trap, and wing shooting, the ensuing howl was comparable to that which rewarded efforts of the Reverend Forsyth 132 years ago. We have before us at this moment a letter from "Bill" Weaver which sets forth some strong arguments in favor of his 'scope, which is $9\frac{1}{2}$ inches long, weighs ½ pound, and has a field of view of 75 feet at 100 yards. It has normal eye relief of 4½ inches, but will function satisfactorily at from $3\frac{1}{4}$ to 7 inches, and illumination is approximately 120. Reticule consists of a round black dot at intersection of crossed hair lines.

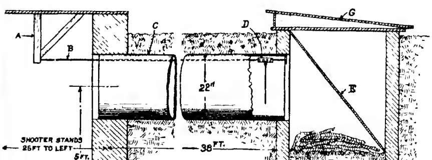
Weaver claims regardless of speed, target may be instantly caught in 'scope, shooter knows exactly where center of pattern will be and how he is swinging, 'scope simplifies problem many have of shooting with both eyes open, for while aiming is done with one eye, target is seen with both, thereby making it easier to pick up target and judge its position and speed, target is seen more clearly than without 'scope due to light-gathering qualities of the instrument, eye does not have to be accurately centered—it can vary $\frac{1}{2}$ inch or more sideways and four inches fore and aft.

Revolutionary as it sounds, we won't start condemnation proceedings on shotgun 'scopes without a trial, for we'd awfully hate to think that by damning something new we'd make the same mistake as an army which said the detonating principle of firing was "dangerous" and preferred to defend its "Tight Little Isle" with flintlock muskets.

This Is The Range That Rod Built

WHEN Mr and Mrs Rod Risley decided to build their attractive and modest little residence in the hills of Westchester County, some 32 miles north of New York City, Rod, being something of a revolver and pistol shot, tried to figure a way to install a small caliber range in his own basement. To be completely satisfactory, Rod decided, the proposed range had to give him 60 feet of shooting distance, offer some satisfactory method of muffling the sound, be kept at a minimum cash outlay, even if some personal

At the shooting position in Rod's range. Note the spotting 'scope



Rod's range, not to scale. *A*, braced rafter for target trolley terminal. *B*, twin wires for target carrier. *C*, smoke stack (shooting tunnel) in trench. *D*, target carrier. *E*, steel plate bullet deflector. *F*, bullet cushion. *G*, cover of "cubicle."

Target and trolley. Opening of the shooting tunnel is in background

labor and puttering were involved As the plans for the new home specified a 25 by 30 foot basement the first problem was how to fit a 60 foot range into a 30 foot room

Scouting around the country side, the amateur range builder found an old laundry smoke stack of 1/8 inch cold rolled steel, 22 inches in diameter Fortunately, there were two sections, each 19 feet long, so Rod consulted his slide rule and ended by buying the stack Still keeping in mind cost of operations, Rod helped his contractor dig a shallow, 38-foot long trench which extended into the back yard, with a box like hole about 30 inches in width, length and depth at the far end When the sections of stack were delivered, they were rolled into the trench, the end nearest the house was fitted into a hole previously left in the foundation, the joints were well tarred to keep out moisture, and dirt was shoveled in on the steel "tunnel" The cubicle like hole at the far end had meanwhile been lined with a four inch wall of concrete on all four sides and had been topped with a wooden cover, weatherproofed with asbestos shingles

By this time Rod's new neighbors were in stitches, trying to emulate Sherlock Holmes To them, the contraption was an air conditioning plant, a new fangled fruit or vegetable cellar, or part of the sanitary system, but Rod said nothing and departed for another country scouting trip This time he returned with a rusty steel plate 5/8 of an inch thick, 25 inches wide, 32 inches long --and an armful of old inner tubes from heavy duty truck tires The steel plate went into the cubicle in a diagonal position and the inner tubes were slashed into sizeable pieces and piled on the sand under the plate, although the neighbors still didn't understand, Rod had completed his bullet-deflecting apparatus

Rod now found he had a distance of 63 feet from the far side of his basement, through the circular hole in the foundation and on down the "tunnel" to the place where the target would eventually be placed Waterproofed electrical cable was strung through the "tunnel" and connected to a light socket equipped with a reflector to throw the light down onto the target. A target carrier of strap iron was constructed in the shape of an "H", with holes drilled in the cross bars of the "H" so that the carrier would ride freely on twin tracks of wire which had been stretched from a basement rafter to the concrete cubicle

The range was finished, the neighbors were finally satisfied, but Rod wasn't He still wanted to muffle the sound, so he built a wooden box 13 inches wide, 16 inches tall and 4½ feet long He lined it with Johns-Manville sound proofing material and succeeded in so muffling the firing reports that Mrs Risley, upstairs in the living room, never dropped a stitch in her assiduous rug-hooking avocation She actually thought her industrious husband was trifling at something with a small hammer instead of firing a round of some 30 shots To complete the comfort of his indoor range Rod rigged a bracket from the rafters in which he could insert his telescope at eye level and thus peer into the "tunnel" to count the score after shooting, thereby avoiding hauling the target carrier back into the cellar

Having accomplished the dual feat of fitting a 60 foot range into a 30-foot basement and of adequately muffling the sound, Risley sat down and computed his costs as follows second-hand steel smoke stack, \$15, cement, \$1 50, electric cable, socket, and switch, \$1 50, extra labor \$5, wire, pulleys, rope and strap iron for target carrier, \$2 50, sound proofing material, \$2. (No charge for wood in either muffler box or 'scope bracket it came from crates and left over pieces around the house) Total cost, \$30 50 Equipped for a standard 50 foot target, the range has proved an "all-fired" success

Pot-Shots

AT THINGS NEW

RKO PATHE's new Sportscope, "Gun Play," shows dramatically in slow and normal motion the interesting possibilities of trap and skeet shooting, particularly so because it was filmed on the 2000 acre preserve of New York's Trout and Skeet Club where special ranges are designed as nearly as possible to simulate true conditions of grouse, woodcock, dove, and quail shooting Active participants throughout the picture are Eltinge Warner and Bob Nichols, respectively Publisher and Skeet Editor of *Field & Stream*, Frank Kelley, captain of 1937 All American Skeet Team, Steele Roberts, and A. G. Boesel

HIGH STANDARD MFG Co adds to their 22 automatic pistol line Models A, D, and E which are equipped with new, long handle, free from magazine projection These guns have automatic slide locks, heavy barrels, and shoot all makes of 22 rim fire cartridges, high speed and low pressure All have Patridge wide blade front and adjustable rear sights, positive safety, walnut grips, blued finish, 10 shot capacity and choice of 4½ or 6¾ inch barrel Standard equipment with Model E is choice of right or left thumb rest grip, and, together with Model D, this gun has a heavier barrel than Model A Thumb rests on Models A and D are extra

ABERCROMBIE & FITCH, in their 1939 fall gun catalog, devote 136 pages to a full range of imported shotguns and rifles, domestic models of all types and prices, and feature their 50th Anniversary as exclusive United States representative of Auguste Francotte et Cie, famous Belgian gunsmiths, by presentation of the Francotte Jubilee double-barrel, hammerless, ejector shotgun in 12 to .410 gage

Conducted by **JACOB DESCHIN, A.R.P.S.**

How Fast?

WITH so much stress being placed of late on the matter of high-shutter speeds, we thought it might be in order to provide a comparison of results obtained at relatively slow and high shutter speeds. We set up a toy pinwheel and kept it revolving with the aid of an electric fan, at a steady pace while we made a number of exposures at different shutter speeds The effect of partial and complete stoppage is partly illustrated in the pinwheel demonstration reproduced in the three examples shown here The first example, taken at 1/10 of a second, shows no sign of stoppage at all, giving the effect of a disk The last, at 1/1000, stopped the wheel practically so "dead" that, paradoxically, it looks as if it had been photographed when at a standstill for all the evidence of movement that it shows

1/10 of a second

1/200 of a second

1/1000 of a second

Between these two extremes a variety of effects were produced, respectively, at 1/50, 1/200, 1/300, and 1/600, that furnish some idea of motion evidences achieved at different shutter speeds. It is interesting to note that no really strong difference could be observed between the exposures made at 1/25, 1/50, and 1/100, and that the first truly visible difference occurred at 1/200 second

Camera On The Air

THE first nationwide radio program devoted exclusively to photography for the amateur was inaugurated in the New York studios of WJZ recently under the guidance and leadership of Herbert C McKay, F. R. P. S, well-known photographic writer and technical consultant. The half-hour program is given every Wednesday evening at 10.30 o'clock over the Blue Network's more than 50 stations throughout the country and is known as "Adventures in Photography," or The Radio Camera Club, membership in which is open to every amateur photographer, who has merely to drop a card or letter to the club, care of Station WJZ, New York City, to become a member.

Mr. McKay, who created the program and is its technical director, advises that a national picture contest is under way under the sponsorship of the club The goal of the program, according to Mr. McKay, is "to make the Radio Camera Club a common bond among all individuals and groups interested in photography."

Two of the interesting highlights of the

program are the features, "What's Wrong With My Picture, Please?" and a dramatized photographic problem. The former is a sort of question-and-answer box which comprises a round-table discussion including, among others, a professional photographer, an advanced amateur, and Mr McKay himself. Questions are proposed by listeners and the round table discusses the reply over the air Kip Ross and Guy Lombardo were the guests on the first program which, incidentally, drew a studio audience of more than 300 persons The dramatized problem, which winds up the program, presents a question in story fashion, listeners are invited to write in their solutions.

Binding Color Slides

NEXT to dust and lint, curling transparencies are one of the worst bugaboos of the color slide maker This is particularly true of the short Bantam Kodachrome strips. An effective way to overcome this and to keep the slides as flat as possible under the circumstances is to cut and bind the slides the day they arrive As soon as you open the package, unroll the strip and hold it unrolled for a few minutes If you will cut and bind the slides then and there, you will find comparatively little trouble with regard to curling Also, you will thus avoid too frequent handling of the strip before it is bound and, as a consequence, prevent to some degree the accumulation of lint on the transparency surfaces

Contrast In Lighting

THE accompanying illustrations provide a graphic example of the negative results obtained with flat lighting and the effectiveness of lighting so arranged that a more faithful reproduction of the subject is achieved Figure 1, as can be seen, shows the subject illuminated from the front by a single light placed near the camera This type of lighting, though useful in color photography, where the colors in the subject themselves provide the needed contrast, is lacking in interest when photographing in "black and white" Perhaps this is not a happy example, because the subject is all white, or, rather, light-toned. However, ex-

Figure 1

Figure 2

cept where one is trying for a high-key effect or some other special result, a flat lighting in black and white will seldom prove attractive

On the other hand, Figure 2 provides almost a startling difference when compared with Figure 1 The light in this case, also a single unit, was positioned behind the camera and above it, the beam being directed down towards the subject at an angle of about 45 degrees In both Figure 1 and Figure 2, the light was in front, but a variation in the height and angle of the light made all the difference in the world Figure 2, as a result, shows depth and roundness, solidity, strength, and character, whereas Figure 1 is practically lifeless

Ray-Del Contest Extended

PROMPTED by letters received from amateurs asking for extension of closing date of the Ray-Del Picture Contest after learning that all prints were to be developed in Ray-Del, the manufacturers have pushed the date ahead Prints for entry in the contest will be accepted until December 31, 1939 The contest calls for pictures depicting the idea of "Balance"

It's The Man Behind The Camera

BELIEVE it or not, a $2 50 box camera can take good pictures—and win prizes too Witness the example of Carl Bakule, of Minneapolis, who paid 50 cents down and 10 cents a week in order to acquire a camera which he otherwise could not afford Carl has built his own darkroom, flood lights, and other equipment out of tin cans, bits of metal and boards, and other odds and ends. In a "write-up" in the Minneapolis Star-Journal, it is reported that "his film is bought a roll at a time He can afford only a few sheets of paper at once . . . and he has rarely, if ever, spoiled a picture or a print." Carl says "he can't afford" to miss exposures "because every bit counts."

Among the numerous occasions on which he has won prizes is the selection of his

photograph "Student of Science," as part of the 58-foot mural, "Youth Around the World," in the International Y M C A. building at the New York World's Fair Carl's picture was one of 63 chosen from more than 1000 entries from amateur photographers in various countries

Carl writes us that recognition for one of his pictures in last year's Scientific American photographic contest was his "first great inspiration ' His letter follows

"I am one of your last year's photography winners (Honorable Mention) I would like to say that your contest was my first great inspiration and I look upon your magazine as helping me find my forte (If you could have seen me when I received your letter!)

"Soon after your contest, I won a one year subscription to the *Camera Magazine* in the Minneapolis Public Library Salon Since my first victory with you I have had a good deal of success which is helping me attain my destination I haven't at present a very good position and through doing photographic exhibiting I hope to attain a good name in order to get a good position in the photographic line "

More power to you, Carl!

SEE WHAT YOUR PAPER CAN DO

SOMETIME ago we described in this department the method employed in making a test strip in order to determine the exposure time required for a given set of conditions as to negative density paper contrast, distance of negative from the easel, and so on This called for the use of a strip of paper, narrow bands of which were successively exposed for a given length of time This same method can be used in making a so called gray scale of each of the various papers you use, exposing them in the same manner as the printing test strip If the test is carried through for all your papers, you need never wonder again as to the range of tones your paper is able to produce Also, it will help you considerably in matching the paper to the particular negative A gray scale of this type (reduced in size) is illustrated here

A gray scale

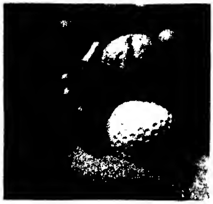
All you need is a sheet of photographic paper and a piece of cardboard or other opaque material to limit the area you are exposing. Recently there came on the market a handy device for performing this routine in a convenient, simple, and accurate manner. It is called the Haynes Gray Scaler and automatically covers up successive steps of the test strip.

Lighting by the Clock

SEVERAL persons appear to have discovered simultaneously that the placement of light sources may be conveniently identified by following the hour numbers of the clock. Thus, with the light at 12, its position is directly over the subject, with the light at 6, its position is from below. Similarly, when at 9 and 3 it is at left or right of the subject. And so on, with the other hour numbers used either in a vertical or horizontal circle around the subject.

Midget Bulb Brings New Phase in Flash Photography

BY the time you read this, the "mighty midget" flash-bulb, hardly bigger than a walnut, will have become available as a regularly marketed product. The bulb is being introduced, according to General Electric Company, the manufacturers "on the occasion of the tenth anniversary of the Photoflash lamp's debut in America for it was in 1929 that the Mazda lamp manufacturers introduced the first flash bulbs in this country."



Comparisons

Known as the Mazda Photoflash Lamp No. 5, the bulb is so small that more than two dozen may be carried in the pocket of a suit coat and more than three dozen in an overcoat pocket or a lady's handbag. Featuring a bayonet type base, similar to the bases of lamps used in automobiles, the bulb is wire filled, is coated with a lacquer safety jacket, and has a total light output of 13,000 to 15,000 lumen seconds. The bulb may be fired only with dry cells (two or more), not house current, and is designed for use with all cameras except those of the focal plane shutter type. The advent of the "mighty midget" presages the introduction of smaller and less cumbersome reflectors.

In this connection, it is interesting to recall a prediction along these lines in the August, 1938, issue of the *Gevaert Sensitizer*, in which C. W. Gibbs, A. R. P. S., wrote as follows:

"Speaking of flash bulbs it is our opinion that, now that the bulbs are being made so small, the next advance in their manufacture should come in the reduction of the size of the base so that these small bulbs and the smaller bulbs of the future would fit the socket in an ordinary flashlight. Photographers seldom use 110 volts for igniting the bulbs and such an advance could result in a saving of equipment if it were only necessary to carry around a fountain pen flashlight for ignition instead of the present apparatus."

Depth of Focus and Depth of Field

THESE two terms are popularly used interchangeably, but one hears the term depth of focus more often than the other. Actually, so long as a term is generally interpreted in the same way, it really does not matter a great deal, except to philologists, whether the term is used correctly or not. One might point to quite a number of words in the English language that, in the strictest sense, denote something altogether different from the meaning popularly attributed to them. The same with the terms depth of focus and depth of field.

Depth of focus is generally understood to mean the extent or depth of field from the plane nearest the camera to that farthest away in which objects are sharply recorded by the lens at a given aperture and distance from the principal point of focus. Correctly, this phenomenon is termed depth

of field. Depth of focus, on the other hand, refers to what might be called a latitude of sharp focus, a narrow field, within which any one of several points may be used as the point of "sharp focus" This will be readily understood by those who have focused on a ground glass You will remember that on occasion, after you had focused on one point and found it sharp, you were able to move the focusing screen a little, or accidentally jarred it forward, and found that, despite this, the focus remained visually undisturbed We know, of course, that there can be but one point of sharpest focus, but this is only theoretically so, because the eyes, and it is with these, after all, that we attempt to focus an image, can actually focus on several different points and obtain visual sharp focus at any one of them Since we have no other means of focusing except with the eyes we must, therefore, take their evidence for it

How To Light A Sphere

TO still all curiosity from the start, let us explain that the picture shows a bath soap ball—nothing more—which is the only thing, curiously enough, that we could find that would answer the description of a white sphere The two tell-tale highlights at side and front tell the lighting story in a moment One light was placed at the side, the other in front In this manner the tonal range is permitted to progress evenly from brightest to darkest area and thus describe the shape of the sphere Unless care is exercised in placing the lights, particularly the front one, which must be moved back and forth until the desired effect of even progression of tone is achieved, a shadow band will show in the center, caused by the greater intensity of the side light.

Study In Triangles

OF course we do not recommend our "Triangles" as a method of portraiture. We all know that the lighting has still to be completed by a soft light in front to fill in the shadows and illuminate the eye One of the reasons for making it was to provide a subject for an exercise in pattern-making Here we have a succession of light triangles, in the forehead, the cheek, the

"Triangles"

nose, and shadow triangles in the area around the eye and the area between lip and cheek The answer might be, So what? And maybe you are right However, it does seem to offer some possibilities in the way of trick photography, puzzle picture making (Guess who?), and so on The lighting was from a single source directly over the subject and slightly adjusted to light the areas shown

Camera Books For Rent

A LARGE photographic supply store in New York City has hit on the idea of inaugurating a circulating library of photographic books on the plan of the fiction rental libraries that have been in vogue for years From the worn appearance of the books on the rental shelf and the report of the management, it appears that the scheme is going over in a big way Fulfilling the store's expectations also is the fact that borrowers, after reading the book, have, in a number of instances, been inspired to purchase a copy.

WHAT'S NEW
In Photographic Equipment

If you are interested in any of the items described below, and cannot find them in our advertising columns or at your photographic dealer, we shall be glad to tell you where you can get them Please send a stamped envelope with your request

B2 Shur-Flash ($3 95) and A8 Cadet Flash (price not yet announced) Box cameras featuring built-in synchronization and separate flash units. May be used for "straight" photography by day or by night, or for synchronization of flash and shutter for flash exposures Flash unit is light and compact, providing polished metal reflector on light-weight plastic base. Uses two pen-light-size batteries and can be fitted with any one of several types and sizes of standard photographic flash lamps. B2 takes eight 2¼ by 3¼ inch pictures on B2 rollfilm. High-quality meniscus lens, two diaphragm openings; optical direct-view finder; easy loading with hinged back having secure latch; compact, rigid; attractive water-proof covering trimmed with black enamel and satin finish chromium A8 takes eight 1⅝ by 2½-inch pictures on A8 rollfilm

Victor Flash Synchronizer ($8 75) Synchronizes shutters equipped with cable release socket, at speeds up to and including 1/500 of a second Features Easy attachment to any camera, uses no battery current except for igniting lamp, shutter tripping drive will trip either automatic or pre-set shutters with uniformly accurate timing, protects shutter mechanism by stopping cable plunger at exact tripping point, release button operated simply as cable release, difference in pressure on release cannot upset timing, quickly adjusted or set for any shutter, synchronizes all speeds of shutter when adjusted to any one of them, has adjustable height reflector to center any flash bulb, polished aluminum, 6 inch reflector

Agfa Speedex Camera ($27 50) Lens $f/4.5$ anastigmat, 85mm focal length Shutter speeds ½ second to 1/250, time and bulb Measures 5¾ by 3⅝ by 1½ inches closed Takes twelve 2¼ by 2¼ inch pictures on B2 rollfilm Focuses 3½ feet to infinity by adjustment of focusing ring on lens mount Shutter of pre-set type released by button mounted on camera body Molded top contains eye level view finder, built-in shutter release, opening release button and winding knobs New type, self-erecting platform and front, brings lens and shutter assembly quickly into rigid picture taking position Recessed tripod socket centrally located on base of camera, single film window peephole positioned in center of camera back Special eveready leather carrying case available at $4 75

Saymon Brown Exposure Meter ($1 85) Gives direct readings Entirely self contained Measures ½ inch by ¾ inch by 1¾ inches overall Chart based on films having 24 Weston rating, instructions provide for adjustments from 8 to 128 Simple adjustment of meter to individual eyesight at start sets system for all future readings Finished in chrome, equipped with leather case Can be used held in hand or fitted into camera shoe Shoe can be supplied for 25 cents

Master Leicameter Has all Weston features, but gives readings in direct shutter speeds "High Illumination" scale gives direct shutter speed readings from ½ second to 1/1000th second Reading is based on 24 Weston and diaphragm opening $f/6.3$ For "Low Illumination" scale, film speed is 50 Weston, and scales based on use of $f/2$ diaphragm opening Calculator dial indicates diaphragm stop to use when film speeds are used other than those on which scales are based Calculator dial can also be employed to determine shutter speeds to be used at various diaphragm openings, for any particular opening

Lafayette "Anodized" Tripod (2-section, $8.49, 3-section, $9 95) · Made entirely of aluminum. All parts "anodized", process finish which resembles stainless steel both in appearance and resistance to wear and scratches Friction joints "Stica" lined to provide firmer locking with less pressure and to avoid slipping likely to occur in metal-to-metal friction contacts; also per-

nits adjustment of tripod at any height Reversible tips provide choice of rubber pads or metal spearheads to insure firm grip on any floor or ground surface Large diameter machined aluminum head provides firm seat for large and small cameras, preventing vibration caused by flexing of camera case itself when supported on small surface

HOLLYWOOD VIEWER PROJECTOR ($39 50)

Combination viewer and projector for 35mm slides Built of aluminum, baked dull enamel finish Viewing screen mounted in deep set viewing box, permitting slides to be shown in daylight, or, with turn of knob, viewer is changed into projector Cooling system efficient, 100 watt projection lamp used Accommodates slides of any thickness Available are black carrying case with compartment for slide file ($4 50) and slide file for 100 slides that fits into carrying case ($2 50)

TALBOTT 35mm STRIP PRINTER ($1 50)

Consists of die cut mat board printing frame and lamp housing complete with cord, switch, 7½ watt opal bulb In operation, merely frame negative and paper, place lamp housing over aperture, and expose

CARCHEE TRANS SHARP (Model K for Kodachrome), 25¢, (Model D for Dufaycolor, 40¢) Designed for viewing negatives and transparencies

F R DARKROOM PAPER CABINET ($3 95)

Accommodates one full gross 5 by 7 inch paper, one full gross 8 by 10 and one half gross 11 by 14 paper Made of wood Interior divided into several sections to accommodate various paper dimensions Shelves finished smooth Cabinet permits quick access to all sizes of papers Light trap makes cabinet light tight Metal clasp keeps cabinet shut when not in use and prevents door from accidentally opening Rubber domes on bottom prevent table scratches Light in weight, guaranteed light tight

WILLO SPOTLIGHT No 88 ($1 50) Completely enclosed unit with condensing lens which concentrates small, bright spot Uses No 1 Photoflood or other high intensity bulbs Complete with cord, plug, and heavy clamp

VICTOR SUNFLECTOR Designed for balancing lighting when making exposures in direct sunlight Compact and portable Sunflector is nine inch, convex mirror formed to curvature of 40 inch diameter sphere Mounted in aluminum casing Chromium finished support, through friction joints, may be variously positioned to direct reflected rays as desired Front feet rubber-tipped Chromium finished loop forms base or provides means of hanging Sunflector on wall hooks, pegs, etc May be used as spot light for highlighting when subjects are in shade, for concealed lighting, and specially effective in relieving shadows in color photography outdoors Most useful in movie and still photography when subject is single figure or close up

SOLAR, JR MINIATURE ENLARGER ($39 50). Optical system employs three inch condensing lenses Standard equipment includes 2 inch Wollensak f/4 5 enlarging lens Negative carriers available for double frame 35mm and half-vestpocket negatives

CAMERA ANGLES ROUND TABLE

JACOB DESCHIN, conductor of our "Camera Angles" department, will answer in these columns questions of general interest to amateur photographers. If an answer is desired by mail, enclose a stamped, addressed envelope. Queries should be specific, but Mr. Deschin cannot undertake to draw comparisons between manufactured products nor to advise on the purchase of equipment or materials. The Editor

Q. I have six rolls of film exposed three years ago, not developed. They were given normal full exposure. What special precautions should I take to obtain the best possible result?—L. V. P.

A. Develop the films for 20 percent longer than the normal developing time. For example, if development for a given temperature is 15 minutes, prolong development to 18 minutes. This should result in satisfactory negatives if nothing has happened to affect the emulsion since the negatives were exposed.

Q. Will you kindly give me information as to the best method, as well as the most economical, to obtain positives for projection purposes from 35mm black and white film?—P. A. S.

A. This procedure is exactly the same as that employed in making contact prints from negatives. The 35mm negative is placed in close contact with 35mm positive film, emulsion to emulsion, with the "glass" or celluloid side facing the light. Regular printing devices are available for this purpose, but a less expensive method is the use of the 35mm wooden printing frames designed for printing either one or six at a time. Process the 35mm positive film in accordance with the formula recommended by the manufacturer.

Q. Will you please explain the differences between a focal plane shutter, a front shutter, a Compur shutter, and a Robot shutter in their actual operation?—H. S.

A. The focal plane shutter consists of an opaque rubberized fabric or metal curtain which moves under spring action close to the plane of the film. The speed is varied by adjusting the spring tension or varying the size of the opening or slit which extends the whole width of the picture area. A front shutter is a so called "silent" portrait shutter consisting of a set of moving blades and which is used in front of the lens and is operated by a cable release, adjustments being made for time, bulb, or an instantaneous exposure, the latter usually being about 1/25 or 1/50 of a second, the actual speed depending on the pressure exerted on the release. The Compur shutter is of the so-called between-the-lens type and consists of several blades of very thin metal which rapidly open and close. The speeds are regulated by a spring-operated escapement consisting of a train of gear wheels. The shutter of the Robot camera is a special disk type design which is operated by a spring motor. When the latter is fully wound up, as many as 24 exposures may be made in rapid succession without the necessity of rewinding.

Q. Can you give me an effective formula for a print cleaning solution?—L. K.

A. Make up a little solution containing equal parts of ammonia, wood alcohol, and plain water. Apply with a soft rag, rubbing gently over the print surface.

Q. Recently I saw a reference to the fact that a "buffered borax" formula can be made merely by adding boric acid to D-76. Can this be done and if so, how much per 32 ounces of D-76? How does the buffered borax formula compare with D-76 as to grain and the effect on film speed? The camera directories list the Leica as Model II, III, IIIa and IIIb, while the camera shop ads call them Model D, F, G, etc. What is the relation between these two methods of reference?—J. A. H.

A. By adding 14 grams (203 grains) of boric acid crystals, the D-76 formula is converted to the "buffered borax" formula, which, therefore, is as follows:

Water (about 125° F.)	24 ounces
Metol	29 grains
Sodium sulfite, desiccated	3-1/3 ounces
Hydroquinone	73 grains
Borax (20 Mule Team)	29 grains
Boric acid, crystals	203 grains
Cold water to make	32 ounces

At 65 degrees, development for fast emulsions is 20 to 22 minutes, for emulsions of medium speed, 16 to 18 minutes. The grain of the developed image is finer, without any apparent loss in emulsion speed.

The numeral designation of the various Leica models, formerly employed only abroad, has recently been adopted in this country to replace the alphabetical system. Becoming accustomed to a change from one system of model designation to another naturally takes a little time, especially since the alphabetical system has been in use here for such a long while.

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AMERICAN MEDICINE MOBILIZES

By James Rorty

RORTY, the author here presents one side of an at present extremely controversial subject, that is group medicine compulsory health insurance, governmentally subsidized medical care and "bringing adequate medical care to all the people" subjects on which there is much, very much to be said on both sides Readers who prefer a calm, objective, unemotional, and scientifically weighed discussion of such issues probably will be irritated by this book which is at times scornful of opinion not fully in agreement with the author's Those who enjoy a fight will like it, if they also like its point of view It is an excellent compendium of arguments favoring socialized medicine, flavored with a bountiful background of gossip about prominent personalities (358 pages, 5½ by 8½ inches) —$3 10 postpaid —*A G I*

SYNCHROFLASH PHOTOGRAPHY

By Willard D Morgan

FLASHLIGHT bulbs, used over a wide variety of natural lighting conditions, have done much to change and enhance photographic technique Here is told the whole story as it applies particularly to the advanced amateur—equipment and how to use it under all conditions (200 pages, 6 by 8½ inches, 200 photographs and drawings)—$2 10 postpaid —*A P P*

PATENT FUNDAMENTALS

By Adelbert Schapp

A TREATISE on patent, trade mark and copyright procedure including information about assignments, licenses, and so on, written in non technical language The book is particularly valuable to the layman in furnishing information which will guide him in obtaining proper protection for his developments (176 pages, 5½ by 8½ inches, illustrated)—$2 10 postpaid —*J P D.*

BETTER BUSINESS LETTERS

By L E Frailey, B A

EVERY business firm in the country should purchase copies of this book and pass them to all employees and demand careful reading The results would be finer, more human, and decidedly more modern letters than are now ground out by the millions daily One important result would be the elimination of such rubber stamp phrases as "In reply we would wish to state," "We are pleased to attach hereto," "Beg to acknowledge," "Thanking in anticipation," "Hoping we remain," and numerous other holdovers from the dull 90's This book covers various types of business letters, correspondence problems, promotion letters and has a large section devoted to lectures and quiz questions Numerous examples of letters, good and bad, are given (198 pages, 5¾ by 8½ inches)—$2 10 postpaid —*F D M*

FIELD BOOK OF ANIMALS IN WINTER

By Ann Haven Morgan, Prof Zoology, Mt Holyoke College

AMATEUR (also professional) naturalists will find here a mine of detailed, collected data on the ways in which animals meet the crises of winter by hundreds of stratagems, endurances, and fine adjustments with their surroundings hydras, rotifers, bryozoans, leeches, insects, spiders, snails, fishes, frogs, snakes, turtles, birds, mammals, and numerous others Many odd surprises for the uninitiated (527 pages, 4 by 6½ inches, pocket size, 282 illustrations)—$3 60 postpaid —*A G I.*

MACHINE DESIGN

By Stanton E Winston

HEAVY in mathematics, this volume presents those fundamentals of theory and analysis which are basic to the field of machine design It is intended as a reference for the designer as well as a textbook for the student in this field Its range is indicated by some chapter headings Fundamental principles—simple and compound stresses, bolts and screws, shafting and keys, friction drives, spur and bevel gears, and others (333 pages, 5¾ by 8½ inches, numerous illustrations.)—$3 10 postpaid.—*F D M.*

GUN COLLECTING

By Charles Edward Chapel
(1st Lt U. S. Marine Corps, Retired)

ANY gun fancier who has never ridden the hobby of firearms collecting will, in all probability, reach the last page of this book with the firm resolve immediately to inaugurate his hitherto neglected gun gathering activities A pleasing, narrative style smoothly and rapidly motivates the presentation of historical and informative data on antique arms and the pleasure and profit to be had from their ownership. Although written for the novice, and therefore equipped with an excellent glossary, index, bibliography, and source lists of collectors, museums, and periodicals dealing with the hobby, the veteran also will find this volume well worth adding to his library (232 pages, 5 by 7½ inches, 15 illustrations.)—$2.60 postpaid —*A. D R., IV.*

MODEL RAILROADS IN THE HOME

By Earl Chapin May

MODEL railroad fever may be compared with a disease, one is either susceptible or immune In this book the author exposes the reader to the hobby For the immune he explains some of the fascination, and how it all started For the susceptible he tells how to start, build, and operate a system Many interesting sidelights and pointers are offered for those infected with the fever The latter will particularly like the vocabulary section in which many terms of the special jargon of railroading have been listed, with definitions (248 pages, 5 by 7¼ inches, illustrated)—$2 10 postpaid *L B P*

DIESEL ENGINES, THEORY AND DESIGN

By Howard E Degler, M E, M S

STUDENTS and designers in the automotive field will find this book to be a practical text on Diesel engines, dealing as it does with such phases as efficiency, thermodynamics, fuels and combustion chambers, testing and performance, and principles of design It is not in any sense of the word a book for the beginner but is written rather with the assumption that the reader is equipped with a knowledge of the principles of mechanics and has a general acquaintance with internal combustion engines Thorough understanding of the text requires a certain amount of mathematics (270 pages, 6 by 8½ inches, well illustrated with drawings and half tones, graphs and tables)—$2 60 postpaid.—*A P P*

CHEMICALS OF COMMERCE

By Foster Dee Snell and Cornelia T Snell

INTENDED as a source of information on the composition of actual commercial products, this volume is written in language which any user of chemicals can understand The authors have departed from the usual dictionary style of presentation in that all material has been classified according to type of compound Each type—there are 36—is covered in a chapter which starts with a discussion giving the general back

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ground and chemical nature of the particular group. The chapter method of presentation will permit rapid and easy comparison of related products Completely indexed (542 pages, 5½ by 8½ inches)—$5 10 postpaid—*L B P*

MATTER AND LIGHT

By Louis de Broglie, Professor of the Faculty of Sciences of Paris

SERIOUS readers of the new physics, either professional or well-informed lay, will find here the noted Nobel Prize winner's approach to the whole of modern physics: a general survey, matter and electricity, light and radiation, wave mechanics, philosophical studies on quantum physics, and various other subjects It contains a small amount of calculus and is intermediate in difficulty (300 pages, 5½ by 8½ inches, unillustrated)—$3 60 postpaid —*A G I*

TOOL MAKING

By C B Cole

THE tools that a workman uses or that a designer makes are discussed in detail in this volume which gives complete instructions for making and using them The range is all the way from personal tools to such large machine tools as arbor presses, drilling machines, lathes, shapers and planers, and so on Heat treating methods for use on most tool materials, including steels, alloys, brass, bronze, and aluminum are clearly outlined Equipment necessary for such treatment is described in detail There are many pages of working drawings and tabulations of bills of material (413 pages, 5¼ by 8½ inches, numerous illustrations)—$3 60 postpaid—*F D M*

LIGHTPLANE FLYING

By Wolfgang Langewiesche

FLYING for sport or business is a possibility that frequently occurs to a large number of people But is it safe? Is it too expensive? Is it difficult? Does it really have sufficient advantages to offset any of its disadvantages? A noteworthy attempt to answer these and other questions has been made in the present book which is written, not from a technical angle, but from the point of view of the average person who really would like to know what lightplane flying is all about If the reader is at all susceptible to suggestion, a careful perusal of this book will make the way much easier for lightplane salesmen (214 pages, 6 by 9½ inches, a number of illustrations.)—$2.60 postpaid.—*A. P. P*

PATTERNS OF SURVIVAL, AN ANATOMY OF LIFE

By John Hodgdon Bradley

ONE place that philosophy touches science is in the realms of biology "If there is any meaning for mice or men in the restless drive of life," the author writes, "a billion years of living should contain it. To search those years for that meaning will be the object of this book." It deals largely with the old questions of vitalism and mechanism, and leans to the vitalistic side with the various outlooks that usually go with that side. (223 pages, 5½ by 8¼ inches.)—$2.35 postpaid.—*A. G. I.*

The Editors Recommend

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(Revised List)

1. SOILLESS GROWTH OF PLANTS—*By Carleton Ellis and Milton W Swaney* Complete information, popularly presented, regarding the problems and difficulties of tank farming Formulas for chemicals and instructions for preparing tanks and other containers are given Recommended to both experimenters and commercial growers **$2.85**

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TELESCOPTICS

A Monthly Department for the Amateur Telescope Maker

Conducted by ALBERT G. INGALLS

FROM the day when the book "Amateur Telescope Making—Advanced" was first published, with its detailed chapter on Walkden's Richest Field Telescope, this compact type of instrument, nicknamed the "RFT," became popular The Richest-Field Telescope is designed on the basis of scientific data to show at one Milky Way view the greatest possible number of stars in one field, and the viewing in the Milky

Figure 1: RFT, version by Morse

Way is very milky indeed—myriads of stars. Such a telescope is quite small and stubby—it is demonstrable both in theory and fact that a large telescope would show fewer, not more, stars It has a rather deeply curved mirror and therefore is not suited to the tyro's maiden job since deep mirrors are harder to make, but could be the amateur's second or third job Foreign commentators say we Yankees "go" for anything biggest or smallest, longest or shortest, heaviest or lightest, or anything, so long as it ends in "est," and so there must now be hundreds of these Richest Field telescopes in use, judging from reports we receive Here are pictures of three of them The first (Figure 1) is by E H Morse, 2401 Mar Vista Avenue Altadena, California (see photo of his 15" reflector in "ATM," p 355) It has a $5\frac{1}{2}''$ mirror of 22" focal length "It has exceeded my expectations in performance Morse writes "In fact," he continues, I have had more fun with it in two hours than I have in many nights with my large telescope"

The "RFT" in Figure 2 was made by Howard P Smith, Jr, 405 North Park Avenue, Tifton, Georgia, and has a 6" mirror of 20" f l Smith states that "the definition is superb" He puts in a claim to being the youngest to make an "RFT"—age 14 As very few youths under 18 ever make telescopes—for telescope making is essentially an adult hobby—we suspect he will retain his record easily enough

The third "RFT" (Figure 3) is by B L. Harrell, 114 South Street, Gadsden, Alabama It has a $4\frac{1}{4}''$ Pyrex mirror of $20\frac{1}{2}''$ f l, in a cedar tube, and is equatorially mounted on an old transit tripod

"HERE'S something that, until a few days ago, was quite new to me, and I feel that the amateurs should know about it," Russell W Porter says in sending the note which follows.

"I think I am safe in saying that the average mirror maker, when testing with the knife edge at the mirror's *focus* (note, *not* at the center of curvature) takes it for granted that an even and uniform cut off indicates a perfect paraboloid However, this seems to be not precisely true, when the pinhole and image are sufficiently separated for convenient observation The following note, made by Dr John A Anderson, executive officer in charge of the 200" telescope, will show clearly why the cut off should *not* be uniform when testing a paraboloid at the focus"

'The other day,' Dr Anderson states, 'one of our opticians called me in to see the test of an f/4.6 paraboloid of 26" aperture The set-up was the regular one with a full-

Figure 2: RFT, version by Smith

sized flat, and the conventional Foucault knife edge Pinhole and image were separated by a small distance—about ¼" or less The optician had found that the cut-off was not changed by rotation of the paraboloid on the flat The small diagonal also was found to be free from suspicion

'In the horizontal cut-off,' Dr Anderson continues, 'the shadows came in from the left and right equally [see Porter's drawing, Figure 4 *Ed*] and in the vertical they came in from both ends of a diameter inclined about 45° to the vertical

'A reference to pages 100 and 101 of Dr Gardner's "Optical Design", or any other description of the formation of pure third order coma, will account for the above observations exactly. The interesting thing to remember is that the effect is so easy to observe even when the off-axis angle is only 3⅓ minutes of arc.'"

Supplementing this compact statement by Dr Anderson, Porter writes, "It should be noted that the shadows referred to are somewhat fainter than the familiar shadows seen at the center of curvature The diagrams may help to show what actually takes place Figure 4 is the appearance of the shadow when the knife edge moves in from the left Figure 5 represents three zones, *a*, *b*, *c*, arbitrarily selected on the mirror, and the numbers 1 to 8 refer to octants discussed below Figure 6 is a schematic diagram showing the three images formed by the zones *a*, *b* *c* of the mirror Now if the knife edge cuts in from the left in Figure 6, it collides with light rays coming from 1 and 5 on the mirror Hence the shadow shown in Figure 4 If the knife edge makes a vertical cut off (say, from below) it extinguishes light reflected from 2 and 6 on the mirror, and hence the resultant shadows creep in at 45°

"The images," Porter continues, "produced by an off axis pinhole and knife edge are included in a 60° angle (regardless of the separation) This off axis condition can be overcome by interposing a half silvered diagonal on the mirror's axis, as in Figure 7 The diagonal must have a minimum thickness to avoid double reflections One method, described in Strong's new work, "Procedures in Experimental Physics," page 75 is to half silver a film of lacquer stretched over a frame"

"The full title of the book referred to by Dr Anderson is 'Application of the Algebraic Equations to Optical Design' by I C Gardner, May 1927, Superintendent of Documents, Government Printing Office, Washington, D C"

FLATS are sometimes as temperamental as prima donnas H F Dall, 166 Stockingstone Road, Luton, Bedfordshire, Eng

Figure 3: RFT, version by Harrell

land, relates in a private communication, how one misbehaved "I had an experience with a flat which I made for A. P. Norton (of star atlas renown) which has rubbed home its lesson The flat was for a Newtonian and was a properly shaped oval of $2\frac{1}{4}$" minor axis, 11/32" thick I started by making a circular flat large enough to cut out two ovals, using polished plate completely free from strain, one side to be

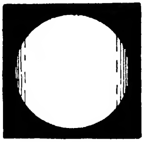

Figure 4: Horizontal cut-off

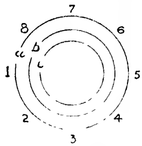

Figure 5 Three arbitrary zones

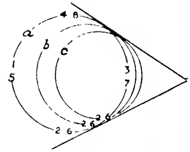

Figure 6 The deep-dyed theory

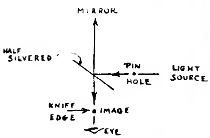

Figure 7: Half-silvered diagonal

ground and worked to a flat. I succeeded in getting flatness within 1/20 wave in four or five hours' total work Now comes the rub! I cut it in half, lathe-ground, an oval from one half, ground the back and, on testing it before silvering, found it was no longer flat The error was a regular bend of a few millionths of an inch—far more than I could tolerate for a first-class flat, although even then it would take a trained eye to detect its effect in the telescope. No alternative but to cut another flat, using the remaining half This time I didn't grind the polished back and on test, when finished, it still was flat! The apparent

THE BEGINNER'S CORNER

SEMI PORTABILITY, permitting a telescope weighing 100 or 200 pounds to be trundled out of doors and, within the limits of one's dooryard, shifted from place to place, is often forced on the beginner by circumstances. Later, when the long eared telescope bug has bitten him till he is far gone and past hope, he may throw up his job, sell his home, and drag his wife into the country to live where there is a wide horizon and better seeing, and there he may have a telescope on a fixed base under a permanent housing.

Two semi-portable telescopes mounted on caster trucks are shown here, the first an 8" made by H. R. Fertig, Chief of Yard and Terminal Operation, Rock Island and Pacific Railway Co., Chicago, Ill. He calls it "From Junk to Jupiter," as the mounting is made of old motor car parts. For the pedestal, a rear housing was bolted at its bell end to a truck, or "dolly," on rubber-tired swivel

casters. As this would be far too light and top heavy, a half barrel was set around it and filled with concrete. Guy wires add to the stability. Total weight, 250 pounds. "I know of nothing I have ever undertaken before," Fertig states, "which gave me the satisfaction of seeing my rub rub rub, night after night, slowly develop into a telescope. It is also a beautiful thing to see Saturn come into the edge of the field of view and pass across the mirror without even a blur."

Another semi portable is the one at the right, made by Robert E. Smith, D. D. S., Medico-Dental Bldg., Sacramento, Calif. Starting at the bottom it has three castors; a 3/16" steel plate reinforced with angle iron, a welded iron taper, 3½" standard pipe, a 3½" to 2½" welded reducer, 2½" double-heavy pipe welded to a piece of the same diameter, machined for inside bearing, 2" double heavy pipe also machined internally. Welding was done in local shops. The whole is both neat and mechanically well proportioned. Such a mounting should be inexpensive.

TELESCOPTICS

(Continued from preceding page)

explanation is in line with some earlier experiences of the surface tension effects of polished glass, and the moral is: 'don't grind the polished back of a flat mirror after finishing the front.' "

JUST as we go to press, the November number of the *Journal of the Optical Society of America* comes out, containing an article entitled "A New Method for Testing Cassegrain Mirrors," by Dr. E. Gaviola, of the Observatorio Nacional at Córdoba, Argentina. Too long (4 pp.) to reprint here at present, the gist of it may be gathered from the following.

Dr. Gaviola (whose photograph, by the way, appears in "ATMA" at p. 474 and who has done much research at Pasadena —see also p. 76, "ATMA,"—and who is especially keen on mirror refinement) was confronted with the problem of testing and correcting the Cassegrain secondary of the 32" telescope at the La Plata Observatory, but had no flat of that size and no Hindle sphere. So he thought up the new test. Directly in front of the convex he put a mask—typical kind. Close to that he put a convergent lens—a bad lens serves as well as a good one—a trifle larger than the secondary and with *f.l.* shorter than the *r.c.* of the convex. Using monochromatic light and a test rig in which k-e and slit were virtually coincident, he determined the position of the image of the various zones. Next, he removed the convex from the set-up and put a small flat at proper distance beyond the lens, so that the new image would return to the k-e end, and once more measured each zone. Amateurs who want to try it may obtain the November number of the "J.O.S.A." from the offices of the Optical Society of America (American Institute of Physics), 175 Fifth Avenue, New York, for 60 cents.

In the same number of the same journal there is a 15 page paper by Ricardo Platzeck and Dr. Gaviola, entitled "On The Errors of Testing and a New Method for Surveying Optical Surfaces and Systems." Fortunately, it involves precision in workmanship not ordinarily reached by the beginner. The paper shows that the regular method of testing is not accurate enough to

work to a close degree of precision. The new method consists of determining the *caustic* or line of the centers of curvature of the surface elements. The method may be used in the Cassegrain secondary test described above, also to determine astigmatism, to study Schmidt correcting plates, single lenses and lens systems A wire is used for k-e, to give higher precision Note from Porter, Pasadena: "Gaviola has just been here and told us of a new way of making k-e test at c of c Dr Anderson says it's O K If so, then all mirrors thus figured are over parabolized" Evidently the same test And how Ellison, if he were alive, would chuckle! Vindication for his under correction argument

Figure 8 Coelostat by Morse

As stated above, these two papers came out on the day when the present notes had to be sent to press, so there was time to read only the first one better than sketchily The second is illustrated with interesting focograms of secondary zones too subtle to be seen in ordinary testing also, unlike the first, is plagued with several acres of higher mathematics An effort will be made to have the low down on it for later publication In the meantime, let none but advanced workers worry about their mirrors now being all wrong

SUN telescopes, described in Porter's part of "ATM," seemingly seldom are made Just why amateurs pass up the only star whose details any telescope can reveal at all, and whose details are varied and ever-changing as well as conspicuous, is something of a puzzle Anyway, E H Morse, 2401 Mar Vista Ave, Altadena, Calif, has made a 6" sun telescope whose coelostat is shown in Figure 8 "It has 15' f 1" he writes, "and is mounted in my workshop on a plan very similar to that of the Snow telescope on Mt Wilson All three mirrors are unsilvered, which brings the light down almost sufficiently for the eye, although I have a selenium glass wedge to reduce glare when necessary Observations of the ever-changing features of the Sun are even more interesting," Morse states, "than the sameness of double stars, clusters and so on."

In your copy of "ATM," unless you have the recent and corrected *printing* of the fourth edition (that of 1935—the most recent *edition*) we suggest that you rearrange page sequence as follows Change p 37 to 42, 38 to 39, 39 to 40, 40 to 41, 41 to 37 and 42 to 38, and thereafter read in that sequence. How these pages ever got out of sequence, and stayed so many years thus without being complained of by any reader, is a second puzzle. How the book's editor also failed to discover this is more easily explained: he just hadn't, until recently, ever sat down and read the book straight through—too much like a busman's holiday!

See our other advertisement on page 41

CURRENT BULLETIN BRIEFS

(The Editor will appreciate it if you will mention Scientific American when writing for any of the publications listed below)

SEEING, by Dr Matthew Luckiesh, is a 20-page booklet devoted to the human eyes, their uses and abuses, and how they may be adequately protected against early deterioration by the proper use of light for various purposes A number of illustrations serve to emphasize pertinent parts of the text, and a table of "recommended foot candles" summarizes the whole subject *General Electric Company, Incandescent Lamp Department, Nela Park, Cleveland, Ohio—Gratis*

FOTOSHOP ALMANAC CATALOG, 172 pages, is virtually an instruction book for amateur photographers, plus a comprehensive illustrated directory of hundreds of photographic items including cameras and all sorts of accessories Feature articles cover "How to Choose a Camera," "How to Use Filters," "Movie Photography," and many other subjects *Fotoshop, Inc, 18 East 42 Street New York, New York—25 cents on a refund basis*

PRACTICAL AIR NAVIGATION AND THE USE OF THE AERONAUTICAL CHARTS OF THE COAST AND GEODETIC SURVEY is a 209 page book which describes the detailed information to be found on these charts and explains their use in the four present methods of aerial navigation—finding position by reference to land marks, by direction and distance flown, by radio bearings, and by celestial observations A chapter is included on meteorology and the interpretation of aviation weather maps Well illustrated *Coast and Geodetic Survey, Washington, D C—65 cents*

THE A R R L ANTENNA BOOK is a 144-page paper covered book, well illustrated with drawings and photographs, which gives not only the fundamentals of radio antennas, but also presents complete specifications and designs for various modern types *American Radio Relay League, West Hartford, Connecticut—50 cents*

THE RESISTANCE OF NI RESIST TO CORROSION BY SEWAGE is an 8-page illustrated folder which discusses the results of experimental testing in sewage disposal plants The desirable characteristics of the alloy Ni-Resist are pointed out *The International Nickel Company, Inc, 67 Wall Street, New York, New York—Gratis*

SNOW AND ICE PHOTOGRAPHY, by H W. Wagner, is a 96 page booklet, with stiff paper covers, that gives the amateur photographer a broad knowledge of the conditions which must be met and overcome in successful photography of this type *Camera Craft Publishing Company, 425 Bush Street, San Francisco, California—$1 00*

THE MERCK INDEX, fifth edition, is a 1060-page limp bound book containing 5900 descriptions of individual substances, 4500 chemical, clinico-chemical reactions, tests and reagents by the author's name; formulas for preparation of culture media, fixatives and staining solutions, useful tables, antidotes for poisons, literature references and other dependable information *Merck and Co, 161 Sixth Avenue, New York, New York - $3 00*

GREATER SAFETY IN NIGHT DRIVING is devoted to a discussion of the sealed beam headlight system which is being used on over 95 percent of all 1940 motor cars made in the United States It describes the system completely and presents numerous illustrations showing its advantages over older types *Automotive Safety Foundation, 366 Madison Avenue, New York, New York.—Gratis*

101 WELDING IDEAS FOR LOW COST MAINTENANCE is a 16-page thoroughly illustrated pamphlet which tells clearly and simply of the many ways in which welding can be applied by users of machinery and metal products The illustrations show the wide variety of jobs that can be handled by this process *The Lincoln Electric Company, 12818 Coit Road, Cleveland, Ohio—Gratis*

SYMPOSIUM ON PATENTS is a 121 page book which presents eight papers on various aspects of the subject, ranging from "The American Patent System" through "Inventions and Civilization," "Industry and Patents," and "Chemistry and Patents" to "Our National Welfare and Patents" *Anthony William Deller, 67 Wall Street New York New York Gratis to Educational Institutions to others, $1 00 to cover printing, handling and mailing*

WRATTEN FILTERS is a 40 page illustrated booklet which deals with filters from both the practical and theoretical standpoints, and will appeal equally to the commercial photographer and the serious amateur Reference tables aid selection of the proper filter for a given need *Eastman Kodak Company, Rochester, New York—15 cents*

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COMMERCIAL PHOTOGRAPHY WITH THE MINIATURE CAMERA, by C A Goldner, is a 96-page book that can do much to guide the footsteps of the amateur photographer who would like to make a business of his hobby It tells where to look for business, how to get started, and details the most profitable markets *Camera Craft Publishing Company, 425 Bush Street, San Francisco, California—$1 00*

FLUORESCENT MINERALS, by W Scott Lewis, is a 15 page mimeographed pamphlet which explains phenomena of fluorescence and phosphorescence, and tells how various light sources may be employed in experimental investigations A listing of fluorescing minerals is included *W. Scott Lewis, 2500 Beachwood Drive, Hollywood, Los Angeles, California—15 cents.*

LEGAL HIGH-LIGHTS

Patent, Trade Mark, and Related Legal Proceedings That May Have a Direct Effect on Your Business

By ORSON D. MUNN, Litt.B., L.L.B., Sc.D.
New York Bar
Editor Scientific American

APPORTIONMENT

A RADICALLY new basis for calculating damages in suits for copyright infringement was established in a recent Federal Court decision. Heretofore, when a literary or dramatic creation was found to be an infringement of a copyright, it was generally held that the copyright proprietor had the right to recover all of the profits realized by the infringer through the use of the infringing composition. In the case under consideration the Court held that where part of the profits were properly attributable to the copyright work and where the remaining profits were properly attributable to other factors, the profits should be apportioned and only that portion resulting from the exploitation of the copyright should be paid to the proprietor.

The suit was brought by the owner of a copyright on a play, against a moving picture producer, and after rather extended litigation the Court found that a moving picture made and distributed by the producer infringed the copyright on the play. The case was referred to a Special Master for the purpose of determining the amount of damages. The moving picture producer introduced evidence before the Master, which apparently was not refuted by the copyright owner, that many factors in addition to the story contributed to the success and popularity of a play, such as the popularity of the actors, the reputation of the director and producer and the amount and quality of advertising. On the basis of this evidence the Court awarded 20 percent of the profits received from the moving picture play to the copyright proprietor and concluded that the remainder of the profits were properly attributable to factors other than the story.

UNRECONSTRUCTED

THE difficulties encountered by the Reconstruction Finance Corporation in connection with trade marks pledged as security for loans is illustrated by a case before the Federal Court in New York. In return for a loan, a shoe manufacturer had pledged its assets, including the trade mark "Arch Aid," to the Reconstruction Finance Corporation. Thereafter the shoe manufacturer went through bankruptcy. During the bankruptcy proceedings the trustee did not continue the business but proceeded to wind up the affairs of the bankrupt as soon as possible. At a public sale conducted by the trustee, the Reconstruction Finance Corporation purchased the real estate, fixtures, and trade marks, together with the good will of the business and thereafter attempted unsuccessfully to sell the business intact. Finally it was forced to sell at public auction all of the physical assets with the exception of the factory. However, it did not sell the trade marks and good will. In the meantime a former officer of the bankrupt company organized a new company and proceeded to manufacture shoes and to use the trade mark "Arch Aid." In order to protect its assets the Reconstruction Finance Corporation brought suit against the new company to restrain use of the trade mark.

After reviewing the factors outlined above the Court pointed out that under our law a trade mark does not exist in gross but must be a part of a going business. In the present instance the Court pointed out that the trustee in bankruptcy had discontinued doing business, that the Reconstruction Finance Corporation had sold the furniture, machinery, dies, and patterns which were necessary to conduct the business and that accordingly there was no good will or business to which the trade mark could attach. Under the circumstances the Court concluded that the Reconstruction Finance Corporation did not own the trade mark "Arch Aid" and was not entitled to restrain its use by the new company.

In reaching this conclusion, the Court stated:

"The plaintiff's acts amounted to more than abandonment. They amounted to the destruction of what was necessary to the existence of a business to which good will, trade marks and trade names might attach."

RECTIFIED

WE have heretofore discussed on this page the rights of an inventor who discloses an unpatented invention in confidence to a manufacturer. Where an invention is disclosed under such circumstances it is generally held that there is a legal obligation upon the manufacturer not to breach the confidence and the inventor can restrain the manufacturer from using the invention without his permission and can collect damages for the unauthorized use. In certain cases the Courts have gone so far as to hold that the manufacturer was bound by the confidence even though the idea disclosed to him did not form proper subject matter for a patent.

In a recent decision a Federal Court has placed a very important restriction on this principle and has held that in order to impose an implied obligation upon a manufacturer under such circumstances the invention or idea submitted must be new. In the case in question an inventor alleged that he had suggested to a metal refining company the possibility of separating zinc from cadmium by means of a rectifying column and through the use of fractional distillation and rectification. Thereafter it was charged that the refining company used this process without the inventor's permission. After reviewing the testimony submitted at the trial, the Court concluded that the idea of refining metals in this manner was not new and held that under the circumstances no obligation was placed upon the refining company to refrain from using the process.

In this connection the Court stated:

"The evidence also fully supports the finding of the District Court that at the time of the alleged disclosure the plaintiff's idea was not novel. Consequently, even if he had succeeded in convincing the trial court that he had disclosed his idea to the defendant's employees, he still failed to sustain the burden upon him of proving that the idea was novel. This it was necessary for him to do in order to impose an implied agreement upon the defendant to refrain from its use."

REPACKAGING

MERCHANTS sometimes repackage the products of a manufacturer and the question then arises as to the right of the merchant to use the manufacturer's trade mark to designate the repackaged product. It has generally been held in the United States that the trade mark may be used on the repackaged product in a descriptive manner so as to indicate the contents thereof but cannot be used in a denominative manner so as to enable the goods to be passed off as the product of the original manufacturer. In order to prevent confusion the Courts require the package to contain a legend or statement pointing out that the product has been repackaged by the merchant independently of the trade-mark proprietor.

In a recent case a merchant purchased a well known face powder in relatively large packages and then repackaged the powder in smaller packages for sale in the popular priced chain stores. His package was marked with the following statement:

"Bourjois, Evening in Paris, Face Powder, Repacked by Hermida Laboratories, Wholly Independent of Bourjois."

This statement was objected to by the trade mark proprietor on the grounds that it did not clearly indicate that the package was not the original product of the proprietor and that the proprietor was not responsible for the contents thereof. The Court agreed with the trade-mark proprietor and required that the repackaged merchandise be marked with the following notice:

"Hermida Laboratories, Inc., not connected with Bourjois, Inc., states that the contents are Bourjois Evening in Paris Face Powder, independently repacked by Hermida Laboratories, Inc., at Linden, New Jersey, without the authority or consent of Bourjois which assumes no responsibility for the contents."

In its opinion the Court pointed out that in most countries, as for instance England, France, and Germany, the trade mark law does not permit the unauthorized use of a trade mark on a repackaged product. However, under the law in the United States as interpreted by the Supreme Court, the Court concluded that a descriptive use of the trade mark was permitted as long as it was accompanied by a statement adequately indicating the true circumstances and which was not likely to lead to confusion.

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NINETY-SIXTH YEAR • ORSON D. MUNN, Editor

CONTENTS • FEBRUARY • 1940

HEAT caused by the impact of tires on highways is one of the most important problems tire engineers have to face Hence they must duplicate that heat in the laboratory To use actual tires would require large, expensive test machines, and considerable power As explained on page 95 of this issue, the B F Goodrich Company does the job with small samples of rubber in the flexometer illustrated on our cover

18988

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50 YEARS AGO IN . . .

SCIENTIFIC AMERICAN

(Condensed From Issues of February, 1890)

PANAMA CANAL.—"The indications are that another effort will soon be made to complete the Panama Canal . . . and perhaps on a new basis . . . This new plan . . . is to construct a canal that would allow of the swift and easy passage of vessels, and would render healthful and habitable a large area of land that at present suffers from the juxtaposition of swamps and marshes. The project, in short, is to make a lake in the interior by means of the water from the River Chagres . . . As this lake would be 24 kilometers in length, it would only be necessary to cut 50 kilometers, and nothing would impede the course of vessels along this waterway but the strong double chamber lock that would be built at each end."

GUN.—"The 9-inch gun mounting herewith illustrated, and which will serve as an example of the type generally known as a carriage and slide in the British service, is intended to be fired over a 6 ft. parapet or from a gun pit . . . As the platform or slide is mounted on a ring of live rollers, an all-round fire can be obtained . . . A special feature in the gun is its capability of firing at night . . . The ordinary sights are illuminated by a small incandescent lamp, the rays from which, passing through a lens, are converged, so that only a minute point or line of light, just sufficient to distinguish the sight, is obtained . . . The carriage admits of 15 deg. elevation and 7 deg. depression being given to the gun. This allows objects quite close to the gun to be hit, and also of a range of about 8,500 yards being attained. The penetrating power of the projectile, even at this great range, is at least 4½ in. of iron, which is quite as much as some of the older classed but still serviceable, ironclads carry on their sides . . . There is an electric firing key in the form of a pistol, which is held in the hand, so that no delay is occasioned by looking for the firing key."

TUNNEL.—"Work upon the tunnel under the Hudson River, connecting Jersey City and New York City, has been slowly progressing, but in the course of a few weeks is to take a new phase . . . The north tunnel already extends well toward the center of the river from the Jersey shore, and it is proposed to start a lateral connection therefrom to the line of the south tunnel, in order to work both east and west from its center. This would give, in connection with the shore ends, four separate working faces."

CONSERVATION.—"Railroads and the 'man with gun' are proving too much for game, large and small, the first making easily accessible what, not long ago, was remote, almost trackless, wilderness and mountain fastness, and the breech loading gun, especially the magazine type, enabling the veriest tyro to find his mark . . . Happily in the Yellowstone Park are collected some herds of the noble game once roaming the broad continent in countless thousands. What remains is in sad need of protection from the pelt hunter and the wanton slayer."

ELEPHANT.—"The journals of Ceylon have recently mentioned the death of an elephant that was well known on the island and had been seen by several generations of Englishmen . . . He was one of the hundred elephants that were taken by the English government in 1815, when the Kandyan dynasty was overthrown. At this epoch, the elephant was said to be fifteen years old. If this is correct, he died a natural death at the age of eighty-nine years."

TYPE.—"The substitution of mechanism for hand labor in the setting of types, although long delayed, may be now considered as realized, and the day cannot be far distant when the type-setting machine will be the principal reliance in all properly organized printing establishments."

HYDRAULIC TRANSMISSION.—"Few Londoners are aware that there are now under the streets of the metropolis forty miles of pipes charged with a pressure of 750 pounds per square inch . . . The mains are of cast iron, varying in internal diameter from 7 inches to 2 inches, and are kept charged constantly at a pressure of 750 pounds per square inch by powerful engines . . . This power is supplied direct to lifts, presses, and other purposes of a similar character without the use of any engine or power-producing machinery, and can also be used for driving engines of special construction in the same way as steam or gas."

PATENT OFFICE.—"The place of the Patent Office among governmental agencies is as unique as it is important. It is concerned neither with the collection nor the expenditure of the ordinary public revenues. Unobtrusive and unsensational in its work and methods, it asks nothing of the Treasury excepting moneys which its patrons contribute, and nothing of Congress excepting measures to secure its highest efficiency."

SPEED.—"There is no such thing in this day and generation . . . as 'making haste slowly.' If the Chicago business man could be shot through a pneumatic tube into New York City in the space of a few minutes, the limited express train taking twenty-four hours to reach there would no longer be patronized. And if the New Yorker could land in Liverpool in less than two days via an air line, the ocean greyhounds would find their day of usefulness had fled . . . Speed is the necessity of necessities in our time, and if lightning speed can be obtained, nothing but lightning speed will be tolerated."

AGES.—"This century has already passed through the phases of a cotton age, an iron age, and is rapidly being transformed into an electrical age."

AND NOW FOR THE FUTURE

¶ Man is a walking hotel for parasitic worms. By Benjamin Adelman.

¶ Beryllium, a strategic material of war, plays its rôle in alloys. By Philip H. Smith.

¶ Animals used in ancient Roman gladiatorial combats rode on mechanical elevators.

¶ Practical benefits to Industry of pure science research. By A. Cressy Morrison.

"YOU'RE TELLING ME!"

"That's a funny one You're telling me what a great thing the telephone is As if I didn't know!

"Why, I'm one of the main reasons there's a telephone in our house For you can bet your life I keep the folks pretty busy around here

"Just think! If we didn't have a telephone, we couldn't order things in a hurry from the stores And Grandma couldn't call up to ask if I had a tooth And Daddy couldn't talk to us when he's out of town And Mother would be tied down just something awful

"And suppose one of us suddenly took sick? Or there was a fire? Or a robber, maybe? Well, I don't worry about those things when I see the telephone

"Doesn't cost much either, my Daddy says And Mother says, 'I don't know what I'd do without it' "

BELL TELEPHONE SYSTEM

OUR POINT OF VIEW

Patient Money

YOUR true research worker in any of the fields of pure science is having a wonderful time. He is following a system—if such it may be called—that at first glance would seem to the hard-headed business man to be highly impractical. Yet the results are so often eminently practical that the same hard-headed business man must sooner or later accept the system on faith and let the research worker go his own unhindered way.

When the pure scientist sets out to find something practical, he apparently turns his back on the goal. To the casual observer he strays so far afield as to seem to be entirely off the track. But that is the system of pure science. First you must cultivate a large bump of curiosity, a bump that will urge constantly along unexplored paths, regardless of how unpromising they may seem at first. Then you must set out to satisfy that curiosity about all kinds of things that may have any connection, no matter how remote, with the problem in hand. During this process you will perform all sorts of apparently foolish experiments, these often leading to side experiments along entirely different tacks.

Continuing, you will "play" and "waste money," as our hard-headed business man might say. But during the process you will be learning many things which, correlated, soon start to build a picture that holds promise. You will have investigated fundamental principles, accepted certain facts and rejected premises that have failed to prove up. Keeping both eyes open at all times you will have found a hint here, a fragment there. Your imagination, playing over a broad field, will have enabled you to see clearly many things that would escape the observer who was concerned only with end products with practicalities. And out of all this may come a new industry or a rehabilitated old one, based on what you saw in a pinch or a drop of something unexpected.

While du Pont chemists were "playing" with pure-science research, one of them noticed something unusual. A certain procedure yielded a material that was unexpected, unlooked for. The result is told in the article starting on page 78 of this issue. Out of the purposeful playing of these chemists has come a group of industrial products that will definitely influence our everyday lives. Nylon, born of the laboratory and named after nothing, is already "big business." Millions have been invested, indications point toward many more millions; stockings, fabrics, brushes, and other commodities will pour from a figurative test-tube.

Buried in the article mentioned is a near-tragic note, lightly touched upon in passing. At one point in the research, the line of approach that was eventually to lead to success was almost abandoned! Prospects were dark, hope dwindled. But persistent curiosity, backed by "patient money," continued to probe and, probing, came through with a triumph of pure-science research. Here is a lesson that should make many an industrialist hesitate and think deeply before he cuts off the financial life stream which is making possible a piece of research that, at the moment, does not seem to be getting anywhere. —*A. P. P.*

Technological Unemployment

WHATEVER else this year's census will show, it will, from present indications, put the quietus on the theories of the technocrats. We say their "theories" rather than the technocrats themselves for the simple reason that the latter are very much a going concern—at so much per membership.

Just before the turn of the year, industrial production stood at 125 percent of the 1923-1925 average. This was higher than the 1929 average of 119 percent. The roll of the unemployed last October was about 8,150,000. Unemployed in 1929 averaged less than half a million. It is these figures that provide a field day for the "technological unemployment theorists." "Just as we told you," they'll vociferate, "machines have replaced so many workers that we now have better than 1929 production *and* nearly 8,000,000 more idle than we had then."

But just as thousands of would-be economists have ignored certain truths during recent trying years, these theorists will forget to mention to you a few pertinent facts. The most important of these is that, with production now only slightly higher than in 1929, employment in October was nearly 46,500,000 as compared with 1929's average of 47,925,000. Thus, for practically equal production, machines (and other factors) have displaced about 1,500,000 – not 8,000,000.

The principal point here is that of the 8,000,000 unemployed, the largest proportion are new workers. This will show up in the census this year. Also a large percentage of this total are added in the estimates merely because they have re-classed themselves as workers by reason of being on certain "made work" projects or on relief. Otherwise they would never have been considered workers.

Machines have undoubtedly taken their toll of jobs. Shorter working hours have partly offset this. Yet we have done one splendid thing that many predicted we would never accomplish: carried production to and beyond that of 1929. And we have not finished yet. We still have to supply the needs, not only of the six or eight million increase in population, but also of many who have skimped in their buying for fear of the future or because they had to support these others. The prospective market for both raw and finished products is, indeed, enormous. It is represented by both the normal demand and the deprivations of years. Many more years will be needed to meet that double demand and, in the effort to do so, industry will carry production to new heights, far beyond the 119 percent of the momentous year 1929.—*F. D. M.*

Do Men Like Them Thin?

OVERWHELMINGLY do statistics just published by the Metropolitan Life Insurance Company—which ought to know—prove that our women are no longer fat. Detailed tables subdivided by ages and heights show that women of every age group and every height group became lighter by an average of three to five pounds in one decade.

These reductions are attributed to four main causes: Health science has constantly been urging that there is an excess of illness and death among the fat. Fashion decreed the slim figure. Science showed that it is better to eat less of the right foods—those rich in vitamins and minerals—than more of the wrong foods, those rich in calories: quality versus quantity. Finally, machines do more of women's work, and so the women need less working fuel. (Some of the reductions have been badly overdone, also, with illness, even death, the sequel to worship of a downright fetish.)

Thus science seems to have changed things around quite a lot; what will Nature do? If there is anything in Darwin's sexual selection, Nature will defeat some of these man-made changes. In about 20 years there may prove to have been a lower marriage rate among women who are slim now, assuming that men on the whole "don't like them thin." Nature may have the last word, after all—the last laugh.—*A. G. I.*

Personalities in Science

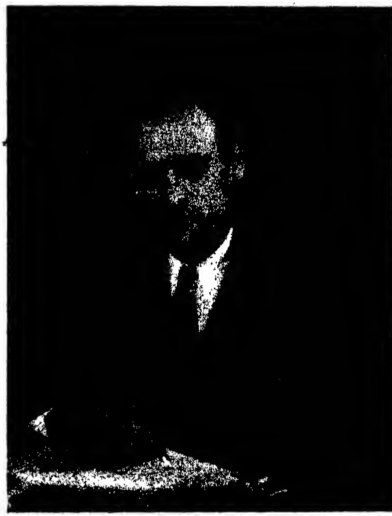
PHILO T. FARNSWORTH — inventor of electronic television — might have made an acceptable concert violinist. That is what his mother had hoped for him. He acquired an elementary skill with the bow at an early age, and even at that time exhibited the kind of persistence that leads to success. But how could a youngster keep his mind on delicate shading of musical interpretation when such complex subjects as Einstein's theory of relativity, the structure and behavior of atoms and electrons, and associated mysteries, haunted his every wakeful hour? The lure of science won.

The pattern of this young inventor's life departs greatly from orthodox stories of scientific success. He is largely self-educated. No hallowed fellowships, no rubbing elbows with eminent researchers in great laboratories, smoothed his way. Yet, in 1921, as a 15-year-old high-school freshman he demonstrated mastery of his theory of television. Farnsworth's very first inventions embraced electronic means for picking up, transmitting, and receiving images via radio waves. There were no moving parts. This was in 1927 when the art of radio broadcasting was still young and Farnsworth was not quite 21.

Today, Farnsworth is vice-president, director of research, and a member of the board of a going concern that bears his name. Farnsworth Television & Radio Corporation.

More than 100 Farnsworth patents cover all manner of television development, applications for 80 additional patents are pending. A long list of these represents unquestionably, original art, and form the basis for significant patent interchange agreements that the company has recently consummated with the Radio Corporation of America and other important factors in the industry.

Farnsworth was a farm boy, at the age of 6 he connected his mother's sewing machine to a toy dynamo and used the power thus generated to drive a toy motor. Later, when assigned as "muscle man" to run his mother's manually operated washing machine, he devised an electric motor drive and spent the new-found time reading science books at the nearest library. He attended school some miles from the farm, covering the distance on horseback. As a high-school freshman, he exhibited definite mathematical genius, "sold" the science instructor on the idea of admitting him to advanced courses, waded through every scientific book on which he could lay his hands, sought special instruction before and after school hours, "crammed" on certain subjects and jumped into college courses in science.

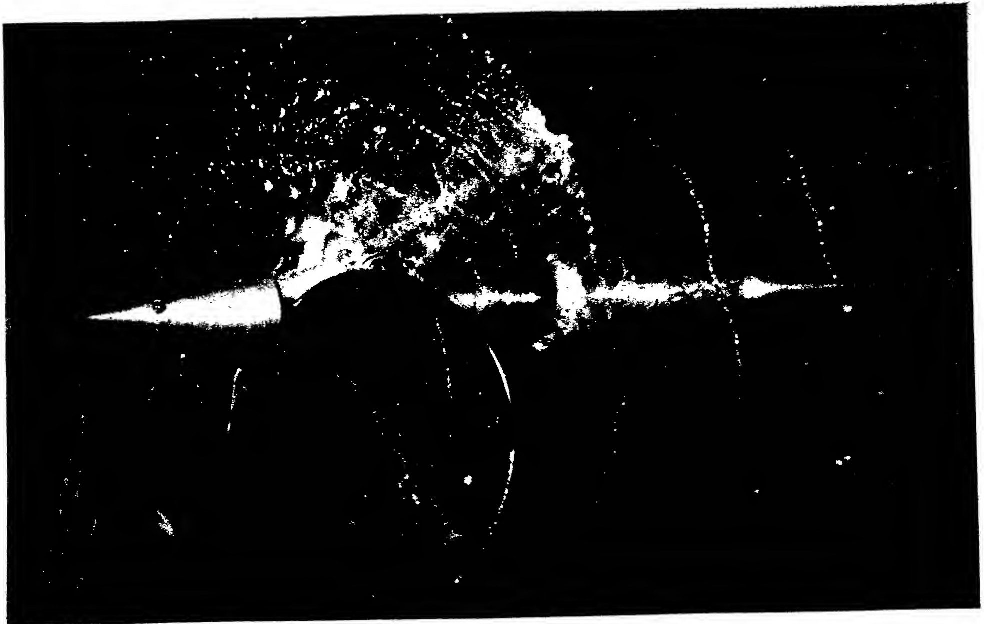


PHILO T. FARNSWORTH

His father died in 1925 and Farnsworth faced the necessity of contributing to the family upkeep. He opened a radio shop. It failed. He took a job in the railroad shops, but the work was too strenuous for a youngster of slight build. He answered a "help wanted" advertisement and was hired as a helper by a professional fund raiser. At this time, the "electronic television theory" appeared to be a long way from realization and Farnsworth decided to write it up as an article and sell it to a magazine. His new employer became interested, took Farnsworth to a Los Angeles patent attorney, who in turn arranged for a consultation with an eminent scientist. The latter expressed amazement at the originality and daring of Farnsworth's plan and said. If you have what I think you have, you have the world by the tail." This statement impressed a banker. The latter "sold" friends on the idea of backing Farnsworth. The youngster promptly married the girl of his choice, rented a small house in Los Angeles and converted it into a research laboratory — the first Farnsworth had ever seen. He and his wife built most of the shop equipment.

Then came the more complex task of creating his pick-up, transmitter, and receiver. Meeting with difficulty in finding skilled persons capable of building his specialized parts, he proceeded alone. Farnsworth repeatedly demonstrated his genius by acquiring knowledge of optics glass blowing, and several other arts essential to the progress of his experiments. Piece by piece, he gradually transformed his theory into fact.

In some respects, the inventor of electronic television resembles a hero of "Horatio Alger" fiction, yet few men of flesh and blood have reached such heights of scientific actuality in the short span of years that cover Farnsworth's life.



FOR PROPELLER DESIGNERS TO STUDY

EFFICIENCY of design of marine propellers, as well as many machine movements, may be studied in photographs such as this one made by light from the stroboscope discussed on page 82. This photograph courtesy "Flash," fascinating book of "stopped motion" pictures

As pointed out in the accompanying article, many crime investigators feel that the old-time head-and-shoulders "mug" pictures of criminals should be replaced by some such modern method of photographic technique as that shown at right

All illustrations courtesy Federal Bureau of Investigation, U S Department of Justice

Photography In Crime Detection

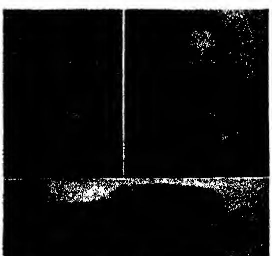
Valuable Contributions . . . Need Seen for Uniformity of Photographic Records . . . Automatic Cameras for Picturing Criminals in the Act

By J. EDGAR HOOVER

Director Federal Bureau of Investigation United States Department of Justice

PHOTOGRAPHY makes many valuable contributions to modern scientific crime detection Without it, the law enforcement officer would be minus many valuable records, deprived of a most efficacious method of personal identification, and seriously handicapped in his technical laboratory investigations of crime.

The police were quick to recognize the value of photography; its first landmark in police history is the early use made by Alphonse Bertillon, Chief of the Judicial Identification Service of France, in the latter part of the 19th Century For many years thereafter the use of photography by the police was generally confined to its application to the problem of personal identification, and in this respect the record and filing factor of the photograph of the criminal was much more highly stressed than it is today In those days the facial features of the criminal were measured, as well as the bony structures of various parts of his body These measurements were worked into a classification system in an effort to record his individuality for filing purposes An important supplement to the classification was the photograph of the criminal which was filed beneath the classification



Suggested method of obtaining front, profile, and full-length views in a "mug" photograph.

The Bertillon system of personal identification, as it was called, has been supplanted today by the finger-print system which is infallible and more easily handled. And today, even though the photograph of the criminal is still placed on his finger-print record card, it is not for the purpose of supplementing the identification system, but rather to have available a copy of his photograph if needed for investigative purposes.

In more recent times photography began to find a new place in police work in providing an accurate record of the scene of crime, traffic accidents, and the like. Figuratively speaking, this permitted bringing the scene of crime directly into the court room and thus giving the jury a comprehensive understanding of the setting.

Naturally, as scientific laboratory practices were adopted in law enforcement for the analysis of evidence, laboratory uses of photography became frequent and most helpful; and today the application of photography to the scientific analysis of evidence is highly developed

"MUGGING" is the police term used to designate the photographing of a subject in custody for record purposes. It is a highly valuable phase of the police record. No longer necessary as a means of classifying the individuality of the person concerned for filing purposes, it is rather used to have on record a recognizable photograph which can be displayed to victims of other crimes for their identification or used if the subject becomes a fugitive sought by law enforcement authorities.

There exists in the United States today a rather deplorable lack of uniformity among police and penologists in the preparation of these "mug" photographs. Perhaps the most prevalent method is to take a portrait type, front

Such photographs of dentures may eventually lead to the identification of unknown dead

and profile view of the head and shoulders of the subject Some effort is being made to standardize the procedure of preparing this front and side view so that a uniform perspective is obtained by all police photographers. There are, however, many critics of this method. Many investigators consider that a full-length portrait—the so-called "stand-up" photograph—of the subject should be prepared These advocates contend that such a picture is much more natural and more readily recognized by a lay witness To this is added the criticism from another school of thought which recommends that the criminal not be photographed alone, either head and shoulders or stand-up, but should always be photographed with his associates in crime, this being the so called "gang" photograph in which a group of three, four, or five criminals are lined up and photographed together

THE next controversy ranges around the clothing which the subject should wear in the photograph Many contend that the picture of the newly committed penitentiary inmate, made after he is clean shaven as to face and head, or otherwise barbered and clothed in a uniform manner, amounts to almost a deliberate effort to render the photograph difficult for use in investigative purposes Again, penologists are being urged to prepare a photograph of the criminal in street clothes just before his release after serving a long sentence in order that the existing photographic record may not be so obsolete as to be useless To this might be added the controversy between those who feel the subject should appear in at least one view with his hat on, as against those who would primp him up with nicely brushed hair for the occasion

Routine photographs are made by police of amnesia victims and of unknown dead This procedure permits wide circularization for identification purposes, including newspaper publications if deemed desirable Of course, the amnesia victim presents no special problem in the photographic procedure. In the case of unknown dead, however, a number of law enforcement agencies have made many advances in the development of special methods designed to produce as near a life-like photograph of the features as possible. Some of this work approaches the artistic in a rather remarkable way Special preparation of this kind not only increases the likelihood of reliable identification but lessons the shock which a gruesome photograph might have on bereaved relatives. Where decomposition is in an advanced state it is sometimes possible to photograph only parts of the body such as the teeth, for identification purposes

Photographs of valuable jewelry are of assistance in case of theft

Searching the photographic file of the single fingerprint section of the Federal Bureau of Investigation at Washington

Another application of photography to the person in police work concerns its use in making a pictorial record of wounds or other special conditions of the body. In cases of vicious assault or murder, photographs of the victim are frequently made and include close-up pictures clearly depicting wounds and other effects of weapons These make a valuable record in discussing the effects of such assaults and graphically illustrating the exact nature of them for the information of the court and jury.

In an effort to improve the likelihood of identification from photographs, police research workers are not only striving for uniformity in making the photographs but are conducting interesting experiments in the use of stereo-photographs, color photographs, and sound motion pictures of the criminal.

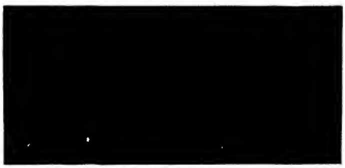
No discussion of police "mug" photographs is complete without a mention of the use of "protrait parle" This system of the "spoken photograph" was initiated by Bertillon and today it has a valuable use in crime detection Investigators are taught how to analyze a photograph in order to memorize the features and readily recognize the countenance of the individual if he is met in the flesh. The investigator learns to divide photographs into types and the classifications are based on such factors as slant of the forehead, the length and shape of the nose, the eyebrows, the ears, and other features of the countenance As a result of such detailed study of the picture, he is able to memorize it and a great many others, and thus recognize persons on the street or elsewhere when he has never seen them before except for a study of the photographic likenesses.

Other uses of photographing for identification purposes include the photographic recording of inanimate objects, such as jewels and stolen articles of various kinds. When the article is being sought after it has been stolen the investigators are limited to the use of pictures made prior to its loss These are usually in the possession of the owner, frequently made for some other purpose On the other hand, booty is often recovered from thieves or their fences and the true ownership established only after photography and publication The police usually recommend that photographic records be made by owners of unique and valuable property which may be stolen; many insurance companies follow this practice.

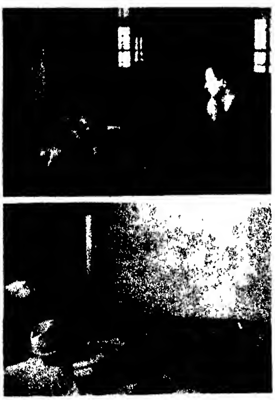
Photography offers the ideal way of graphically portraying the scene of crime, and sometimes in rare instances the crime itself. The modern investigative agency provides for routine and efficient photography of the scene of action in murder cases, assault, certain robberies, automobile accidents, and the like Such photographs become invaluable in a subsequent study of the crime and a re-accounting of the action before the jury or persons not familiar with the scene They become most useful at times in the interrogation of suspects and of witnesses, when they are not only valuable as a pictorial reproduction of the situation for reference purposes, but sometimes act as a surprise inducement to confessions when presented to the criminal who up to that point has reassured himself that the action of the commission of the crime is unknown because there were no eye witnesses at the time of its commission

Particularly graphic in this latter respect are those rare photographs depicting the commission of the crime itself. Several instances of this kind have come to the attention of the Federal Bureau of Investigation A photograph in the collection of a Larkspur, California, citizen depicts a stagecoach holdup reported to have taken place at Ahwahnee, California, in 1901. The picture clearly shows the robber dominating his victim and is said to have been taken by one of the passengers on the coach. Another such picture resulted when a storekeeper of St. Louis, Missouri, after being the victim of a number of burglaries, arranged an automatic camera system equipped with flashlights, whereby he is reported to have been successful in obtaining an excellent photograph of a burglar following entry into his store, the picture subsequently receiving some prominence in the national press Still another such photograph involved the use of a home made affair by means of which a vagrant was automatically pictured when he opened a refrigerator door which was on the porch of a citizen's home in a Maryland suburb of Washington, D C The latter case is particularly interesting in that this same photograph was the means of identifying the thief—when his body was found a few weeks later after having been struck by a railroad train—as a criminal with a previous police record.

Section of a piece of carbon paper, photographed under slanting light, reveals message



Blood spots on a blue coat, invisible to the unaided eye, were brought out vividly when the clothing was photographed



Two examples of pictures taken with concealed cameras, without the knowledge of the subjects pictured Such photography may be of great assistance to law enforcement men

There are frequently in use today secret automatic cameras designed to take photographs of criminals committing an unlawful act With the highly sensitive film emulsions now available, these devices would seem to have some value if the actuating means of operating the camera is a practical one Such cameras have been reported as installed in theater ticket booths where the overhead canopy lighting is favorable, and in institutions where, because of the existence of large sums of money, attempts at robbery are anticipated A good photograph of a criminal act whereby the perpetrator can be identified is indeed a rich prize, but, so far, success has been rather infrequent With further improvements in the manufacture of photographic equipment and film, and possibly with the utilization of infra-red light, greater success may follow Ultimately, perhaps, photographs of marauders will be obtained in pitch darkness

The miniature camera is also used to advantage Candid shots of the criminal or of his activities are sometimes made In this work such accessories as the telephoto lens and right-angle view finders are often helpful

Occasionally a photograph, instead of placing the person charged at the scene of crime, may be used by the defense to show that the suspect was *not* at the scene of crime Such photographs were important in a case some time ago; pictures showed the accused with other persons at a location a long distance from that where the crime took place These pictures also recorded an event, the time of which was identical with the time of the crime Pictures of this latter kind are usually made for some other specific purpose. Frequently, however, details are recorded in the photograph which later become valuable in an inquiry or controversy which may be quite unrelated to the original object of making the photograph and without any intention on the part of the original photographer to have included the incidental information. In this respect photographs are frequently more valuable and complete than the recollection of an individual concerning what he visualized at the time, especially when his attention during the time in question was not necessarily focused on the subject of later discussion.

There was a time when photographers would often say: "What you

Left. **An example of erased writing that was made visible by photography with ultra-violet. *Below, center* The lettering on a leather bag was removed so as to be invisible to the unaided eye, yet shows plainly when bag is photographed by infra-red *Below, right* Upper picture shows a serial number that was changed; lower picture, taken by infra-red illumination, reveals original number plainly**

can't see you can't photograph." In the Scientific Crime Detection Laboratory this adage is certainly a fallacy. Over and over again the camera is utilized to produce a record of that which cannot be seen with the unaided eye. In the Technical Laboratory of the Federal Bureau of Investigation at Washington, photography is an all-important part of the routine handling of cases submitted for examination An "object shot" is made of every piece of evidence submitted to the Bureau's Laboratory for examination This constitutes a valuable record in the files of the condition of the evidence upon receipt. It furnishes the possibility of secondary evidence in the remote event that the original evidence may become damaged or deteriorated. It is used at times in court to establish positively that the original article then in the court room is the same one which was examined in the Bureau's Laboratory at some previous time

DURING one stage of the chemical development of latent fingerprints on paper, fugitive iodine fumes are utilized If good, readable fingerprints are thus found, they can be recorded only by photography for they soon disappear from the paper This is done in the FBI Laboratory by means of a fixed-focus automatic timing camera which produces a picture of the document with the fingerprints thereon at exactly 1 to 1 size.

Special photography is essential in the examination of many problems involving questioned documents. Chemical erasures are detected, and the original writing before erasure made readable, by photography in ultra-violet illumination Hardly noticeable indentations in the paper caused by the pressure of pen or pencil perhaps on another sheet are made plainly visible through photography utilizing special side lighting which throws the hills and valleys of the paper into sharp relief. Special photographic methods have been devised for producing a readily readable photograph of the impressions left on carbon paper Ink strokes which appear to the unaided eye to be the same color and kind can sometimes be definitely segregated due to their different effects on the photographic plate.

Photography with infra-red illumination produces other results. Writing prepared with an ink which is opaque to infra-red, and subsequently obliterated with an over-layer of another kind of ink more transparent to the red rays, may be readily restored by means of photography. Sometimes the ink pigment is worn from the surface so that no evidences of it appear, yet it may be found below the surface by infra-red photography A particularly good illustration of this is the case of a leather money bag, on the surface of which could be seen no writing, an infra-red photograph graphically disclosed the name of the bank from which it had been stolen

X ray photography in the Laboratory is sometimes used to disclose the contents of suspicious packages. The application of X-rays and photography for the determination or identification of materials is also usable. X-rays will disclose many kinds of hidden objects in the shoes or clothing of a prisoner Objects swallowed by persons, or bullets in the bodies of victims, are clearly disclosed through use of the X-ray.

The technical testimony of the laboratory witness in court nearly always is supported by photographs Frequently he prepares large photographic charts in which the fingerprints, the handwriting, or the bullet markings are magnified many times so that the jury can clearly follow his exposition of the identification. An additional advantage of this procedure is that the photographs are introduced in evidence as official exhibits. They thus become a permanent record of the case and may be taken into the jury room where they are of considerable assistance to the jury in reaching its verdict

In order to complete the story of photography in crime detection we must not omit its importance in police training. The Training Division of the FBI, which includes the FBI National Police Academy, is fully equipped with every modern apparatus for visual education. Sound motion pictures, projection slides in color, and large photographic charts combine to provide in a few weeks or months of concentrated training the experience of veterans of many years service.

A BRIDGE THAT FLOATS

Four-Lane Highway on Monster Pontoons . . . Over a Mile Long . . . Tied By Cables to Great Anchors in Bottom Mud . . . Safe, Vibrationless, Permanent

By CHARLES F. A. MANN

THE world's most remarkable highway bridge—with a floating portion 6561 feet long made up of huge concrete and steel pontoons which carry a four-lane express highway—is now the center of engineering interest in the Pacific Northwest. It is part of the Snoqualmie Pass East-West highway across the Cascade range where that highway enters the city of Seattle, on the shores of Lake Washington. This great eleven-unit bridge-highway project runs from the southern heart of the Seattle business district for six and one half miles due east, directly across the middle of the beautiful lake which bounds Seattle on the east, on across Mercer Island, and thence to the mainland. Work on the project is being speeded to have it ready for the rush of summer tourist traffic by July first of this year.

The bridge project is costing $8,854,000. The Washington State Tollbridge Authority, which public body is also constructing the Tacoma Narrows suspension bridge, is the developer of this project. The State Highway Department let a contract on November first for a nine-mile stretch of fast, four-lane, arterial highway that runs directly east toward the mountain town of Issaquah. This stretch is at the eastern end of the bridge project.

The two projects — the bridge and the above-mentioned stretch of highway—chop nine miles off the total distance between Snoqualmie Pass and Seattle, eliminate 65 percent of the curvature and 50 percent of the rise and fall, and save an hour for passenger cars and two hours for trucks on the mid-state highway to the east.

For 25 years, local people dreamed of a way to cross Lake Washington with a huge bridge and avoid the twisting Seattle-Cascade route through Renton, at the southerly end of the lake, and over the rough wooded foothills and canyons. The lake is 20 miles long and runs along the entire eastern boundary of Seattle between the city and the Cascade range. Lake Washington Canal, for deep-water ships, connects the lake with Puget Sound. Even at Seattle's famed Seward Park Peninsula, where the lake is narrowest, the cost of a bridge would be fantastic and too far south of the needed traffic route into the city's downtown shopping area.

It would cost between $35,000,000 and $50,000,000 to build a suspension span across the lake itself, and there was no precedent for such a bridge because no piers have ever gone down to 400 feet below water level. Pier footings would, in fact, have to go much deeper than that Lake Washington, only a few feet above the level of Puget Sound, is very wide and deep. The water varies from 150 to 200 feet deep, and the bottom is soft mud for over 100 feet below that. Jet borings have gone down into this mud nearly 325 feet below the surface of the lake, but there is nothing firm enough on which to rest a giant bridge Such deep piers were, therefore, out of the question.

A recent air photograph of the Lake Washington Bridge showing work progress. "Gate" span will be near gap

Engineering research on this problem finally centered on the present route as the best, and a pontoon bridge was decided upon. The decision sprang, not from desire or design, but from simple necessity Conditions were favorable for the construction of a floating structure There is no current or tide and only a slow seasonal variation of three feet in the water level The lake water is fresh so that it would not deteriorate a floating concrete structure No ice of any consequence forms on the lake in winter Finally, the mud of the lake bottom would provide a strong foothold for heavy anchors which would hold the bridge in place with huge cables

FOR a long time after the decision was made to construct the bridge in this fashion, innumerable questions were directed by Seattle citizens toward Mr Charles E Andrew, Chief Engineer of the Lake Washington Bridge They wanted to know why a concrete pontoon was to be used, and would it sink in a storm, and what holds the pontoons together?

Even the Seattle newspapers were so puzzled that they condemned the project editorially as technically impossible. They were sure the whole thing would sink in a storm As layman, they can be excused for their bewildered attitude for this will be the first bridge of its kind ever built anywhere in the world It is true that there are pontoon bridges across the Rhine at Coblenz, across the Golden Horn at Istanbul, and at Ebrie Lagoon, Ivory Coast, French West Africa—but these are simply bridge decks built across floating boat-shaped pontoons anchored like scows The only other concrete pontoon bridge is now being constructed at Hobart, Tasmania.

The key to the six and one half mile project is the lake crossing of 7800 feet.

At each end there is a low steel truss span, a heavy steel transition span, and a novel floating "gate" on the Mercer Island side This gate opens the structure to provide a clear 200-foot channel to allow the biggest ships to pass The end span system is of ample clearance (30 to 38 feet, with water depth of from 46 to 60 feet) to take care of 95 percent of the lake boat traffic, including tugs, and the floating draw-span will amply care for all the rest

The floating section is 6561 feet in length, made up of 10 identical middle-section pontoons, and 12 of special shape These special ones, with but a slight variation in design, are used at each end in connection with the transition (ferry-slip type) spans and the ship lock on the Mercer Island side The principal or typical, pontoons are 349 feet 10 inches long, 59 feet wide, 14 feet six inches deep Each is made of dense concrete and slightly under 350 tons of closely spaced reinforcing steel bars 5/8 of an inch in diameter This steel is placed in all walls, bottom top, and railing

Each pontoon weighs 4558 tons, and normally floats about seven feet two inches deep in the water The unusual feature of this construction is the utter simplicity The outer walls of the pontoon, the bottom slab, and the roadway slab on top are eight inches thick, while the entire system of inside compartments and the end walls are six inches thick The interior of each typical pontoon section is divided into 96 cells of about 14 cubic feet each Each strip of four cells across is connected by openings to another strip of cells, making eight cells in each of 12 water-tight compartments, any three of which can be injured and flooded without disruption of traffic due to lack of buoyancy

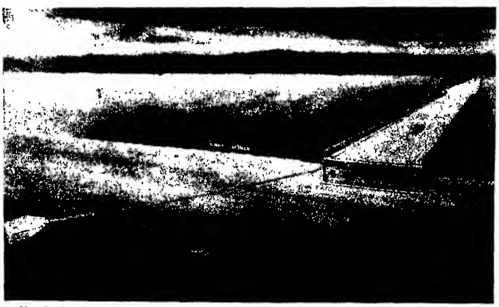
The roadway slab, which carries a four lane, 45-foot roadway, 24-foot side walks, and a three foot concrete guard railing on each side, is integrally a part of the pontoon For each 53 tons of load on the roadway, the pontoons sink into the water *one inch.* Thirty passenger autos on one pontoon would just about add enough weight to sink them down a mere inch!

Sketch of draw span through which large ships will pass The pontoon between the guard "wings" will be pulled back into the "U" of the section at the top

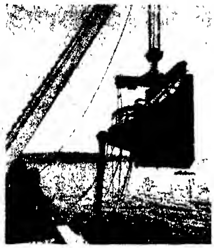
THE loading capacity of the floating section is figured for a 90-mile wind plus four lanes of 20-ton trucks, bumper to bumper Thus the factor of safety is adequate because such a combination is unlikely Should it occur, the pontoons would sink about 22 inches into the water Obviously, the total weight of each pontoon is so great in proportion to any possible load that a 50 percent capacity load driving down one side of a pontoon in a high wind would cause so little vibration and movement that a pedestrian could easily imagine that he is walking on a highway on solid ground A six foot wave height has been provided for by making the railing three feet above the sides of the structure, or normally 10 feet above the waterline

Transversely, through the middle of each pontoon, runs a cable channel and racking mechanism, in a steel beam channel, that carries the ends of two 2¾ inch steel cables into the side of the pontoon These cables run up on a low angle from flat, umbrella-shaped concrete anchors, sunk by water jets into the soft lake bottom, to the racking mechanism inside the middle of each pontoon Hydraulic jacks can be quickly lowered to rack these cable-ends back and forth to take up or let out slack to compensate for seasonal variations of the lake level A movement of 12 feet has been provided for, and their peculiar method of connection with the pontoon prevents, or rather acts against, any tendency of the pontoons to rock in a storm The cable saddles literally tie the pontoon to the lake surface and exert a downward pull The wing-type anchors are 26 feet wide and 14 feet deep.

Each of the pontoon sections is connected to the adjoining pontoon in an unusual manner Around the top, bottom, and sides of each end runs a row of huge three-inch bolts, 54 in all, that run through steel tubes imbedded in the concrete end-walls A double nut locks them securely A soft rubber ring, located around the outside ring of bolts, is squeezed water tight when the pontoons are bolted together. The remaining space between the pontoon ends — slightly over one inch—is unwatered and grouted with dense cement-sand mixture. A third system of shear-stress between pontoons is provided. **This** consists of two three-foot-



Sketch showing section of one pontoon and manner in which a single pair of cables is attached to the middle of each pontoon and to heavy anchors in the mud on each side



Lowering one of the immense anchors, the size of which may be indicated by comparison with the men

square concrete plugs, or keys, projecting into the adjacent pontoon 12 inches. Thus with these concrete shear keys, the 54 three-inch bolts, and the continuous ring of cement grouting, the entire floating section becomes one continuous concrete monolith, with any two pontoons capable of sustaining a completely flooded middle pontoon until any possible repairs can be effected. In such a case traffic would have to be thinned out, of course.

And, say the engineers, nobody knows just how much "bend" or "give" there is in a mile and one-fifth of concrete ribbon, but it is estimated to be several feet, particularly because of the dense steel reinforcing system used in all the walls.

NO painting, or any other repair expense will ever be necessary. The steel anchor cables rest in fresh water, submerged and away from the air. Slight seepage may occur in a faulty panel, but a portable pump outfit can keep the bridge bailed out. Once a month the manhole covers—12 on each pontoon—will be lifted and the interior inspected. It is estimated that about 100 gallons of water per year will seep into the entire bridge, and this is less than normal "creep" of water up the walls and onto the roof, or highway deck, slabs!

Even if all the rubber sealing gaskets give way, the concrete grout extending to within eight inches of the outer rim will keep all water out of the bolt-holes and away from the end compartments.

It is claimed that this is one of the most remarkable pieces of concrete construction ever attempted. Approximately 2110 cubic yards of concrete will go into each pontoon.

On Harbor Island, Seattle, 16 miles from the bridge site, a pair of graving docks was built especially to construct the pontoons. One graving dock is 70 by 365 by 15 feet deep and the other is the same width and depth but is 400 feet long. Steel tide gates are placed at each end. The concrete bottom slab of each dock is floored with wood which makes the bottom form of the pontoon's bottom slab. Concrete for the pontoon bottom is poured on this after the steel mat is laid. After a few hours delay, the interior cell walls, three longitudinal central walls, two outer walls and 25 transverse walls are made in one continuous pour. Vibrators make the concrete very dense around the steel reinforcing wire. Finally, the top slab is poured after the cell forms are removed. All forms are heavily oiled.

Four and one half days from the time the deck slab is poured, the end gates are raised and the graving dock flooded so that the pontoon is simply floated out to be towed by two tugs to the bridge site 16 miles away. After all pontoons are assembled, deck railing and sidewalks and curbing will be poured, and electric lamp posts set.

The entire project begins on Rainier Avenue in Seattle and runs through twin, two-lane self-ventilated tunnels under Mt Baker Ridge a distance of 1400 feet from portal to portal. Thence it goes down to the lake on simple truss spans and one 215-foot arch span to the novel transition span mentioned before. This span permits movement between the rigid portions of the bridge up and down and sideways to compensate for changes in the lake level, traffic load, misalignment of piers due to wind pressure, and wave action. From there the highway crosses the first 15 floating concrete pontoons and runs to the draw-span located 1500 feet out from the Mercer Island shore.

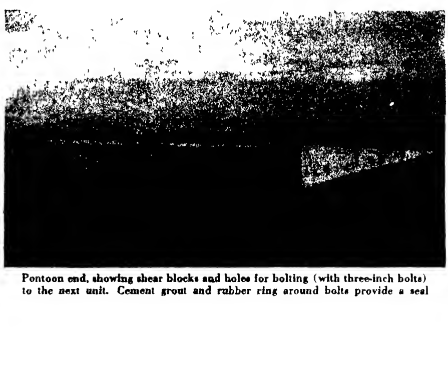
At that point, a 378-foot movable pontoon section can be telescoped into a "U"-shaped section to give a 200-foot clear channel for ships. Special steel buoyancy pontoons will be floated under the "U" arms to compensate for the extra weight of cable drums, motors, and heavy steel track for the floating movable section. Two 75 horsepower, geared motors will work the cables that move the floating draw-section. Each half of the "U" pontoons (a forked pontoon and two narrow side pontoons) will carry a two-lane road. Anchors at the sides, as well as fore and aft, are provided here to carry the extra stresses.

East of the draw section will be another transition span, another arch span, and the approach spans. On Mercer Island will be an eight-lane tollgate. The tolls at this gate will be about 25 cents for each passenger car plus five cents for each passenger, and for trucks it will be from 50 cents to $3.50 each.

THE Mercer Island end of the project consists of a four-lane express highway, with under- and over-pass for local island boulevards and an approach road on both sides. Between Mercer Island and the East shore, two major sections are necessary. The first is a truss and East Channel span 215 feet long, with a clearance of 39 feet and a total length of 1360 feet. This is followed by a 2000-foot highway section and then a 2000 foot concrete viaduct across Mercer Slough.

So long and involved was this project that it was split into eleven units, each under a separate contract. Nearly twenty large Pacific Coast Contractors are engaged in rushing this complicated project through in time to meet a PWA deadline of July 1, 1940.

The Lake Washington Bridge is being built by the Washington Tollbridge Authority, headed by Lacey V. Murrow, Director of Highways. Charles E. Andrew, R B McMinn, Admiral Luther E. Gregory, and R H Thompson constitute the board of consulting engineers, with Mr Andrew as chairman. Mr. Andrew is, in fact, in charge of both the Lake Washington and the Tacoma Narrows Bridges. Mr G A Gregory is project engineer and L R Durkee is the resident engineer inspector for the PWA.



Pontoon end, showing shear blocks and holes for bolting (with three-inch bolts) to the next unit. Cement grout and rubber ring around bolts provide a seal

Air, Water, Coal = Hosiery

Fiber From Abundant Raw Materials . . . Fiber is Only One of a Large Family of Chemical Products Known As Nylon . . . Research That Led To Them

By H. T. RUTLEDGE

FOR many years the du Pont Company has carried out research directed to the improvement of existing products and the development of new products, but it was not until early in 1928 that "pure" or fundamental research was started. Whereas the "applied" research previously carried out was directed to immediately practical ends, the "pure" research begun by the Chemical Department some 10 years ago was designed primarily to develop fundamental information about chemical products and processes, with no thought that the information developed would be of immediate practical value

The first study undertaken in connection with this fundamental research program was directed to a better understanding of how and why certain of the tiny building blocks or molecules, of which all matter is made, unite to form "giant" molecules such as those found in rubber, cellulose, and resins Chemists have long been vitally interested in this subject of giant molecules, technically known as superpolymers, and in learning everything possible about the mechanism of what the chemist calls polymerization, which, after all, means only the process by which large molecules are formed from small molecules Such information has a two-fold value First of all, it satisfies the chemist's inherent curiosity about the constitution of matter He wants to know, for example, what rubber is and why it stretches, and why the cellulose of cotton is in the form of long fibers

An understanding of such processes as polymerization also enables the chemist to direct certain of the forces of nature along desired lines, one result of which is that he is able to make things which nature failed to provide. It is, indeed fortunate that man is endowed with this insatiable curiosity concerning the things which surround him, since it has been through his efforts to understand these things that he has been able to master his environment.

Out of the study of polymerization begun by the Chemical Department in 1928, fundamental information of much academic importance was developed It was demonstrated, for example, that certain small molecules could be made to unite in such a way as to form giant molecules of great length — so-called linear superpolymers, the small molecules being joined together end to end somewhat like a chain of ordinary paper clips

As yet this information was only of interest to chemists who wanted to know more about how matter is built up from the tiny molecular building blocks, but after this fundamental research had been under way for about two years, something happened which was destined to be of far-reaching practical value. In attempting to remove a sample of a molten long-chain superpolymer from the still in which it was prepared, one of the research chemists engaged in this study noted that the molten polymer could be drawn out in the form of a long fiber, somewhat like that of silk He noted also that, even after the fiber was cold, it could be further drawn to several times its original length Such a phenomenon had never before been observed

While this original fiber was not very strong or elastic and, in addition, was softened by hot water, it, nevertheless, suggested the possibility that some related type of superpolymer might give fibers which would possess the characteristics desired for use in textiles Further research was accordingly undertaken, directed to the synthesis of a superpolymer from which strong, elastic, and water-resistant fibers would be drawn or spun This particular research was, of course, of a very practical nature, and we shall not here follow further the fundamental research on polymerization which, however, was continued and is still being carried on.

Aerial view of the new nylon yarn plant near Seaford, Delaware, which started operation in December Production will shortly be 3,000,000 pounds a year

PRACTICAL research directed to the synthesis of a superpolymer from which fibers could be drawn suitable for textile purposes did not bear immediate fruit. Many difficulties were encountered. Numerous superpolymers were synthesized, but some of the resulting fibers were deficient in strength and elasticity, while others, although sufficiently strong and elastic, softened at quite low temperatures, or were sensitive to water. In other words, they did not possess the properties required of a textile fiber The outlook at one time was so dark that consideration was given to suspending this particular line of applied research. But finally a superpolymer of a different type was prepared, known as a polyamide, from which fibers that were spun by hand

were found to possess such characteristics as to warrant extraordinary efforts to bring the development to commercial success.

Much work was yet to be done, however, between that day when the first polyamide fiber was extruded through an improvised spinneret made from a hypodermic needle, and the announcement of nylon by du Pont. Hundreds of different polyamides had to be synthesized before superpolymers having the desired characteristics were found, it was then necessary to investigate sources of raw materials for the intermediates needed in making these superpolymers, and to devise practicable processes for making these intermediates

BUT painstaking study, together with the "patient money" necessary for successful research, finally won out, and on October 27, 1938, du Pont announced to the world the development of a group of new synthetic superpolymers from which, among other possible applications, textile fibers could be spun surpassing in strength and elasticity any previously known textile fiber, whether cotton, linen, wool, silk, or rayon.

Nylon is the generic name chosen for the synthetic linear superpolymers developed in connection with the research just outlined Nylon is officially and scientifically defined as "a man-made, protein-like, chemical product (polyamide) which may be formed into fibers, bristles, sheets, and other forms which are characterized, when drawn, by extreme toughness, elasticity, and strength."

Note that nylon is a "protein-like chemical product." This means that it has somewhat the same chemical composition as the proteins, of which silk, hair, and wool are common examples Nylon does not, however, have an exact chemical counterpart in nature, and fibers made from it cannot, therefore, properly be referred to as "synthetic silk," although resembling silk in certain respects The synthetic material — or rather, family of materials — known as nylon is not only new, but different from any existing natural product.

Again, nylon "may be formed into fibers, bristles, sheets, and other forms." From this definition, it follows that nylon does not refer simply to the fibers or yarn spun from a polyamide, as many thought, but rather to the polyamide itself from which fibers, bristles, sheets, and the like, may be formed. The term "nylon" does not refer to any particular form of the polyamide any more than does the term "glass" refer to any particular form or item of glass. Also nylon does not have reference to one particular chemical compound, but rather to a family of related compounds: the polyamides, of which there are many members.

The superpolymers of the nylon polyamide family can be made in several different ways One of the simplest involves the reaction of a dibasic acid, of which there are many, with an organic diamine, the two hooking together in chains This reaction, which results in the formation of relatively small molecules, is followed by heating to bring about the union of many of these small molecules to give the giant polyamide molecules.

This is, in effect, what happens when a dibasic acid and a diamine are heated together, and the product produced by the reaction is called an amide When the chain is made up of many links, the resulting product is a polyamide.

Since a product formed in this way is a polymer, long-chain polyamides are also spoken of as superpolymers The polyamide superpolymers made from a dibasic acid and a diamine are known as nylon

Though it was indicated above that the polyamide chain might be infinitely long, in actual practice, those in nylon, by proper control of the reaction, are purposely limited in length in order that the nylon may have desired physical qualities for proper mechanical processing of different types

Since there are dozens of different dibasic acids, diamines, and the so-called amino-acids, as well as other compounds which may be used in making polyamides, it follows that many different types of nylon are possible

For example, if there were only 10 different dibasic acids and 10 different diamines, it would be possible to make 10 times 10 or 100 different nylons. Actually, by inter-polymerization of various dibasic acids, amino-acids, and diamines, thousands of different nylons are possible; for example, one dibasic acid could be made to react with two different diamines at the same time, and in varying proportions, or vice versa. Also, two or more different nylon polymers might be blended to give a composition different from that of the parent nylons. It should be apparent, therefore, that an almost unlimited number of nylons are possible — with different melting points, solubilities, and so on. Some, for example, might be quite flexible, while others would be stiff or rigid.

Since nylon is not one particular polyamide, but rather a *family* of related polyamides, it might be expected that various raw materials could be used in making various types of nylon, and such is the case. One particular type which now appears quite promising for making textile yarns can be made from a dibasic acid derived from phenol, and a diamine likewise derived from phenol Oxygen from the air is also needed in making the dibasic acid, and ammonia is used in making the diamine Since phenol is commonly derived from bituminous coal, and since ammonia is made synthetically by causing the hydrogen from water to unite with nitrogen from the air, it follows that this particular nylon is derivable from coal, air, and water Other raw materials might, however, be used to advantage in making other types of nylon For example, one type which has been found useful for certain purposes involves the use of a dibasic acid derived from a vegetable oil It is thus evident that agricultural raw materials as well as mineral raw materials may enter into the manufacture of nylon.

These "blenders" contain nylon chips about to be transformed into yarn for various textiles

WHILE it is of economic and industrial significance that nylon can be made from domestic raw materials such as coal, air, and water, of which this country has an abundance, this is only a part of the story. The layman may sometimes wonder why a product based on cheap and abundant raw materials should not itself be "dirt cheap." He frequently fails to appreciate that, in order to make a product such as nylon from "coal, air, and water," many intricate chemical reactions must be carried out, involving elaborate and costly equipment, with rigid control at each and every step of the process.

The most interesting physical property of nylon is that it can be cold drawn. If a fiber of nylon which has been made under low tension is subjected to further tension, it can be drawn to from four to seven times its original length, depending upon the particular

polyamide being used in that type.

A highly interesting phenomenon occurs during this stretching operation. The long, chain-like molecules which make up the undrawn fiber are arranged in a helter-skelter fashion like the individual straws in a haystack but, on drawing this fiber to several times its original length, the long-chain molecules take on an orderly arrangement. They become parallel to one another.

This peculiar behavior, known to the chemist as "orientation" of the molecules, is more than just an interesting phenomenon, for on this property hinges the very important industrial value of nylon. The practical significance of this property, particularly as applied to textile fibers, is that, on cold drawing, nylon becomes exceedingly strong and elastic. One might think it is originally elastic, since it can be stretched to several times its initial length. But elasticity means more than "stretchability."

THE degree to which a stretched material comes back to its original length is a measure of true elasticity. A piece of warm molasses candy, for example, can be stretched to great lengths but it isn't elastic; it will not spring back. Similarly, if a nylon fiber, made under low tension, is stretched to, let us say, double its original length, it will not spring back, but will remain double its original length. If, however, it is drawn to some four to seven times its original length, depending upon the type of nylon, it becomes truly elastic, with the result that, if it is stretched farther, it does spring back—not, of course, to its original length before being stretched at all but to the length it had when it assumed the property of true elasticity. Even if kept stretched for days, the oriented nylon fiber does not lose its high degree of elasticity.

Drawn nylon fibers possess not only a high degree of true elasticity, but also great tensile strength. Nylon can be drawn into fibers which, for a given size, are stronger than corresponding fibers of cotton, linen, wool, silk, or rayon. The superior strength of drawn nylon is due in part to the fact that the long, oriented molecules lie so close together as to give rise to powerful intermolecular forces which resist slippage of the molecules when tension is applied. Breaking of any material is due only to separation by force of the molecules that make up the material, and closely packed, parallel molecules like those in drawn nylon offer great resistance to separation.

Another factor which contributes to the high tensile strength of drawn nylon is the extreme length of the molecular chains in a nylon filament. Just as a thread made from long cotton fibers is stronger than a corresponding thread made from short cotton fibers, so is an individual filament made up of long molecules stronger than a similar filament made up of short molecules. Although the molecues of nylon are spoken of as extremely long, they are long only in comparison with ordinary molecules. Actually, the "extremely long" molecules in nylon are only of the order of 10 or 12 millionths of an inch in length—too small to be seen even through a microscope.

It is the combined strength-elasticity factor of drawn nylon which causes the yarn to lend itself so well to the manufacture of fine hosiery. Neither strength nor elasticity alone would be sufficient. Until the development of nylon yarn, silk was the only textile fiber which possessed the combined strength and elasticity demanded of a yarn for fine hosiery, but from nylon it is possible to spin yarn having a strength-elasticity factor superior even to that of silk.

Oriented nylon is also extremely tough. It is this property, among others which causes the "bristles" made from relatively large, oriented nylon filaments to be well suited for use in many types of brushes. It is likewise this quality of toughness which causes fishing lines of nylon to wear so well. They are not only strong and elastic, but highly resistant to fraying, that is, they are quite resistant to abrasion.

Durable and sanitary, nylon bristles are here being used to wash bottles, one of many uses

Nylon, in common with other crystalline materials, has a fairly sharp melting point, the temperature depending, of course, upon the particular nylon. Some of the nylons melt at quite low temperatures, while the melting point of others may run as high as 600 degrees, Fahrenheit, or even higher. The melting point of the type which now appears suitable for textile purposes is about 480 degrees, Fahrenheit, which, fortunately, is above the temperature normally used in ironing fine fabrics.

Fabrics made from the commonly used textile fibers will, of course, blaze when brought into contact with a hot flame, unless specially treated to make them flameproof. Fabrics made from nylon yarn, however, do not blaze when brought in contact with a flame. The nylon fabric simply melts and, although the molten nylon is ultimately consumed if kept in the hot flame, the fabric itself does not blaze and propagate flames.

Nylon of the type to be used in textiles is not injured in the least by water or any liquid commonly used about the home, such as dry-cleaning fluids. It is attacked only by certain chemicals, such as phenol (carbolic acid), and certain mineral acids which are normally found only in the chemical laboratory. Furthermore, nylon fibers are substantially as strong when wet as when dry.

Nylon fabrics are at least equally as resistant to indoor and outdoor light as are corresponding silk fabrics. Nylon fabrics undergo no appreciable deterioration in the absence of light, and may accordingly be stored for long periods of time without injury. They are proof against attack by moths as well as by fungi, such as those responsible for mildew.

Because of its good insulating properties and high abrasion resistance, experiments are now being made looking to the use of nylon coatings as insulation for the wires in various types of electrical machinery and apparatus. For this purpose the wire is not simply wrapped with nylon yarn, but is encased in a continuous film applied from molten nylon polymer.

AS made ordinarily, nylon in the massive state — that is, in relatively large pieces — is opaque, but sheets no thicker than about one fourth of an inch are somewhat translucent. Nylon films may, however, be made quite transparent by special processing. Nylon of the type suitable for textile purposes has a refractive index of 1.53 to 1.57.

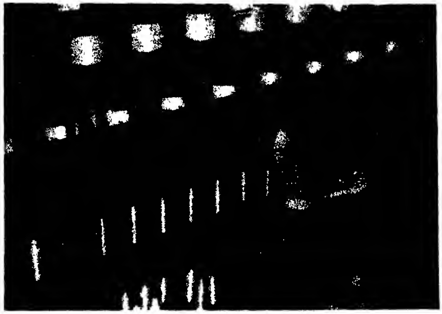
One of the most promising outlets for nylon will be in the manufacture of yarn for fine hosiery. The properties of nylon yarn are such, however, as to suggest its use for a wide variety of textile purposes, particularly where a high degree of strength and elasticity are essential. Among the possible textile applications for nylon yarn are knit goods of various kinds, woven dress goods, lace, bathing suits, underwear, upholstery material,

and the like. Nylon yarn is now finding commercial application in the manufacture of sewing thread and fishing lines, but only in a limited way

A highly specialized possible application for nylon yarn is its projected use in making parachutes, including both the fabric and shroud lines Hitherto, these have been made from silk, only

"Exton" bristles made from nylon have been used on a rather large commercial scale as the bristling filaments in the Dr West's "Miracle-Tuft" tooth brushes Bristles made from nylon have been introduced commercially into various other types of toilet brushes, including hair, nail, clothes, hat, and complexion brushes as well as in many types of industrial brushes Since nylon bristles are resistant to chemicals, oils greases, and other destructive agencies they are well suited to many industrial applications

Since one of the major outlets for nylon will be yarn suitable for hosiery and other textile purposes, the process by which nylon yarn is made is of particular interest



Nylon yarn being processed. Machines twist the bundle of slender filaments for ease in handling. Finished yarn consists of many fibers twisted into thread

THERE are two major processes which may be used in spinning nylon yarn Nylon polymer may be dissolved in a suitable solvent, such as a phenol, and while in solution forced out through a spinneret into a bath which would remove the solvent and leave behind the tiny, solid nylon filaments A spinneret quite similar in general design to that used in making rayon may be used, that is, a cup with as many fine holes in the bottom as the number of individual filaments desired in the yarn

The method now being used is, however, quite different The nylon in molten form is forced out through a spinneret by a suitable pump As soon as the filaments strike the cool air outside the spinneret, they instantly freeze that is, become solid

The filaments from one spinneret are wound up on a suitable device and later given a twist of a few turns per inch to facilitate further handling The process from this point on involves stretching the bundle of fibers, now known as yarn, to the desired degree, applying a "size" or lubricant, or both, to facilitate knitting or weaving, and packaging the yarn in the form of skeins, "cones" or other forms suitable for shipping

Filaments of extreme fineness can be made from nylon — much finer, in fact, than ordinary textile fibers In general, however, such extremely fine filaments are not desired Different textile materials call for filaments and yarns of different sizes and accordingly, the size of a yarn as well as the individual filaments, is adjusted to suit the particular use for which it is designed.

As normally made, nylon yarn has a high luster but by adding a finely divided white pigment to the molten polymer before it is spun, yarn of the desired degree of dullness may be obtained Since this dullness is due to pigment particles *within* the filaments, and not simply on the surface, the dullness is not affected by wear or by washing

In the same way, colored yarns may be had by incorporating suitable pigments with the nylon prior to spinning For the most part, however, nylon yarns and finished fabrics will be dyed in the usual way after the yarn is spun or the fabric knitted or woven Fortunately, nylon yarns and fabrics take a wide variety of dyes

In its Trade Practice Rules for the Rayon Industry, dated October 26 1937, the Federal Trade Commission defines rayon as follows

"The word rayon is the generic term for manufactured textile fiber or yarn produced chemically from cellulose or with a cellulose base "

Since nylon is not produced chemically from cellulose, nor does it have a cellulose base it follows from the above official definition that nylon yarn cannot properly be considered as a type of rayon Furthermore, the properties of textile fibers and yarns made from nylon are quite different from the properties of any existing type of rayon particularly as regards strength and elasticity

A plant for the commercial manufacture of nylon yarn, erected by the du Pont Company at Seaford, Delaware, went into production on December 15 last, in addition, extensions are being made to the du Pont Ammonia Department plant at Belle, West Virginia, to provide facilities for making nylon intermediates. The initial plant at Seaford will have a capacity of approximately 3,000,000 pounds of nylon yarn per year Nylon polymer for monofilament purposes (bristles, surgical sutures and so on) as well as for other possible applications, will also be produced at Seaford The nylon development will provide employment initially for about 1000 persons

NYLON hosiery will be made by a number of nationally known hosiery manufacturers and it is anticipated than nylon hosiery for both men and women will be put on the general market by late spring or early summer of 1940 Nylon yarn will be made in several different sizes, and hosiery will be available in various weights ranging from light sheer to service weight No special precautions are necessary in laundering nylon hosiery Indeed, no more care is necessary in the case of nylon hosiery than with other fine hosiery of the same weight Nylon hosiery knitted in the orthodox manner will, when a thread is broken, run just like any other fine stocking so knit Since, however nylon yarn has a high strength-elasticity factor, nylon stockings should be less liable to runs than other high-quality stockings of the same knit

The manufacturers say that the word "nylon" has no significant derivation; that it was selected as a generic name because it is non-technical and is easy to pronounce, its individual letters do not stand for anything Yet that simple, coined word has taken on a nobility unequalled by any other, at least in so short a time. It represents enormously significant achievement And it should become a symbol of that exploratory research which starts with no practical end in view but results so often in new products that enrich man's life and help to further civilization

Stopping Time

That is What "Whirling Watcher" Does . . . Newest Stroboscope is Light Weight, Portable . . . Allows "Stills" and Movies of Extremely Fast Movement

By ROBERT LITTELL

WITH microscopes and telescopes, science has conquered space, making it possible for man's feeble eyesight to pierce the mysteries of things unimaginably small or far away. And now, much later than these instruments, science has developed another, the modern stroboscope, which freezes the swiftest motions while they are still going on, and seems able to stop time itself.

In the laboratory of Professor Harold E. Edgerton, at the Massachusetts Institute of Technology, one can see time not only arrested but practically handcuffed. Here in a corner, for example, stands an ordinary electric fan, with the letters "M.I.T." painted on one of the blades. When the fan is turned on, the letters quickly vanish, of course, in a rapidly revolving blur. And any layman would be willing to bet that the letters won't be visible again until the fan slows down and stops. But Professor Edgerton aims at the revolving fan with what looks like a sort of searchlight framed in a black box. He turns a knob, and suddenly the letters re-appear on the fan, perfectly legible and stock still, although the blades are whirling furiously. Another turn of the knob, and the letters crawl forward as slowly as the second hand of a watch. Then uncannily they stop and begin to move slowly backward, contrary to the motion of the fan, which all this time has been revolving 1100 times a minute.

In the next demonstration of the handcuffing of time, the bright light from the black box is flashed onto a stream of water which in ordinary light appears to be continuous. In a moment the stream becomes a series of drops that stand still — queerly misshapen little jewels poised in midair. A turn of the knob, and they seem to climb back up into the faucet, defying the law of gravity. Now Professor Edgerton focuses a second flashing box on the water. Suddenly the top half of the stream drips down, while the lower half drips upward against gravity to meet it. The stream of water is composed of drops caused by pulses created by a small pump that circulates the water.

The stroboscope is not merely a toy for the creation of uncanny hallucinations. It is a very useful and important tool of science which, though the optical principles behind it have long been known, and practical models of it long been made, has only recently been fully developed. It is a serious student of the natural world, telling us things we would otherwise never know about how birds fly, how glass cracks, how drops of liquid behave when they fall or splash. And it is an increasingly val-

A portable stroboscope is used by the Boston Gear Works to watch gear-grinding angle and check speed

uable tool of industry. Thanks to the stroboscope, women's stockings are sheerer than ever before; guns will find their targets more accurately; there is less and less unpleasant and costly vibration in your automobile.

The modern stroboscope is a device for producing extremely short flashes of very bright light at regular and controllable intervals of time. The stroboscope which Professor Edgerton shone upon the fan blade marked "M.I.T." produces flashes of light only five millionths of a second long — five thousand times faster than a human wink. And by turning a knob and reading a dial, it can be made to flash anywhere from 600 up to 14,400 times a minute. Even the rapidly revolving fan blade, during such a super-wink as five millionths of a second, will move only a few ten-thousandths of an inch. Now if the light is made to flash 1100 times per minute — just as many times per minute as the fan blade is revolving — the light will always catch the blade marked "M.I.T." at exactly the same spot, and the letters will not only become visible, but appear to be motionless. And what are actually 1100 separate images a minute we see blended into only one because our eyes are able to retain the image of things for a brief moment after they have disappeared.

This peculiar ability of the human eye, which scientists call "persistence of vision," you can demonstrate for yourself by a simple experiment with a lighted lamp. Close your eyes. Then open them to look at the lamp only as long as it takes to wink. Even after your eyes have closed again, the bright light of the lamp persists for the fraction of a second. Now if the lamp can be turned very rapidly on and off, and you keep your eyes open, persistence of vision will bridge the gaps of darkness between the flashes of light, and the lamp will seem to be continuously lit. This optical "after-glow" explains the magic produced by the stroboscope in Professor Edgerton's laboratory.

By making the stroboscope flash a little slower than the fan is turning, or a little faster, the image of the letters on the blade will seem to be moving forward — or backward against its own true motion. The trick of the two-way cascade of water-drops is done with two stroboscopes — one flashing a trifle slower than the rhythm of the drops, the other a trifle faster.

The intensely bright and extremely brief flashes of the stroboscope's light have made it possible to photograph motion far too rapid for even the fastest camera shutter. Some of the startlingly beautiful high speed photographs taken

by Professor Edgerton with the aid of the stroboscope are already familiar to the public They are now collected in his book "Flash," with lucid explanatory text by J. R Killian, Jr, also of M.I.T. Here one can see the slow death of soap bubbles, the squashing of a golf ball at the moment the club hits it, the eddies of smoke at the tip of a whirling propeller blade, the first shy ooze of coffee from between the jagged fragments of a breaking cup With his swift flashing light, Professor Edgerton has caught drops as they fell through the air—and discovered that they weren't streamlined, as had been supposed, but flat on the bottom and lacking the pointed tail. He has snapped milk as it splashed; and one of the pictures of the splash pattern, like a beautiful regal crown, is hung in the American Museum of Modern Art He has caught birdshot as it left the shot-gun, flying somewhat like geese in a V, with the wads tumbling after it A series of his photographs, each taken with an exposure of one millionth of a second, shows what happens when a rifle is fired at an electric light bulb the bullet peeking out of the muzzle at a speed of 2700 feet a second, the first cracks in the bulb as the bullet nudges it, the bullet coming out the other side before the bulb has had time (about one six thousandth of a second) to collapse

Operation of a Pelton water wheel, and the efficiency with which the stream of water is thrown aside, can be studied by stopping action with a stroboscope

SUCH photographs can be taken with an ordinary camera In a darkened room, the shutter is left open, and the exposure is made by a single flash of the stroboscope's light, which, though incredibly brief, is equal to the light from 40,000 50 watt household bulbs Often, to take the picture at the precise moment desired, the flash mechanism of the stroboscope is tripped by sound For intimate snapshots of a bullet in action, the stroboscope is set off by a microphone at a predetermined position some distance from the camera As the speed of the bullet and that of sound are both known, it is a comparatively simple matter, by moving the microphone away from the revolver, to take a picture of the bullet at any given distance from the muzzle.

More amazing even than these stills are the slow-motion movies which the stroboscope makes possible. In Professor Edgerton's laboratory I saw films in which humming birds flapped their wings as lazily as a crow. One could see how they used their wings like propellers with a variable pitch, one could study the mechanics of their hovering, their ability to fly straight up and down Slow-motion films of pigeons showed how the feathers open on the up-beat. I saw exactly how a cat, held upside down a foot above the ground, rights itself in a twinkling to land on all four paws. A snake put his forked tongue out and drew it in again in the tempo of the Volga Boatmen. I saw what no human eye was ever quick enough to see until the stroboscope put time into low gear — the quivering vibration of muscles as a football player kicked the ball, and the huge temporary dent his foot made in it Water flowed from a jug with the slow oiliness of glycerine, high-speed cutting tools stumbled and jerked as if lame, and the decline and fall of a soap bubble when dropped to the floor was as stately as a chapter from Roman history

The slow-motion pictures of prize fights and steeplechases which we see in the newsreels are taken at about six times the normal camera speed of 24 frames a second, and then run through the projector at normal speed But even this speed isn't nearly fast enough for making slow-motion films of humming birds, snakes' tongues, or the action of water bubbles Ordinary movie cameras operate by intermittent motion each frame is stopped short for a fraction of a second, just long enough to record the image admitted by a synchronously intermittent shutter If speeded up beyond a rate of several hundred frames a second, the film may tear or catch fire by friction, and the shutter will be open too short a time to let in sufficient light This problem is solved in one way by a stroboscope synchronized with a moving picture camera from which the intermittent mechanism and the shutter have been eliminated The film speeds evenly past the open lens aperture at rates up to 2000 frames per second, while the necessary intermittent illumination is supplied by the rapid, brilliant, regular flashes of the stroboscope focused on the subject to be photographed. What made the letters on the fan seem to stand still, here records on the racing celluloid an image so nearly instantaneous that the film, during one flash, does not move far enough to cause a blur As many as 6000 pictures a second have been taken by reducing the size of the frames and using the alternating flashes from two stroboscopes

Photographs taken at extremely high speeds, and projected in slow motion, are beginning to be used in industry for the analysis of rapid irregular movement The stroboscope by itself can function only when the motion to be observed is uniform and periodic. But when used in conjunction with this special moving picture camera, unsuspected phenomena often appear.

IN technology and industry the stroboscope is rapidly coming into its own Its commonest uses are the observation of rapidly revolving machinery and the measurement of the rate of revolution Already it is used by many textile companies to regulate spindle speed, on the uniformity of which depends the uniformity of the cloth made from the yarn A workman plugs his portable 10-pound stroboscope into the nearest electric outlet, sets the dial at the desired number of revolutions per minute, and walks down the row of spindles. When the flashing light seems to stop a spindle's motion dead, the spindle is functioning properly The speed of spindles turning too fast or too slow is quickly and accurately determined by varying the number of flashes per minute until they, too, seem to stand still In the same way, shuttles and ring travelers are also kept going at the most efficient speed

The automobiles we ride in are freer from "bugs" than they used to be, thanks to the stroboscope. The vibration of crankshafts, the operation of valve springs, the splash of oil in the

cylinders — all such operations and many more can be fully understood only when the stroboscope catches their secrets and foibles with its motion freezing eye. Only by means of the stroboscope and high-speed photography can engineers observe exactly what happens when fuel is injected into the combustion chamber of a Diesel.

Propeller shaft torsion in a famous transatlantic liner, which made its first passengers complain of unbearable vibration, was located, measured, and finally eliminated with the aid of the stroboscope A stroboscopic moving picture of a movie projector showed that one of the two little metal claws which pull the film ahead was not doing its share of the work, causing the film to tear Electric razors harvest morning beards more painlessly because factory inspectors adjust the cutters by flashes of stroboscopic light. Electric refrigerators are easier to sell when their moving parts, "frozen" still by a stroboscope, are exhibited in salesrooms High-speed color printing is more accurate because the stroboscope can "stop" the presses without moving a lever, and allow the pressmen to see whether the different colors are accurately registered

Thanks to the stroboscope, engineers are better able to forecast what certain heavy materials and unwieldy structures will do under conditions of strain At Columbia University's School of Mines, Professor Philip A Bucky can predict, for example, how much an 83-foot steel beam, weighing 265 tons, will sag under its own weight An exact scale model of the beam is made, one one hundredth the dimensions of the prototype To produce a pull upon it equal to 100 times that of gravity, the model is spun in a centrifuge, and its deflection is observed by a stroboscope and recorded on photographic film In this case, it was found that the giant beam would sag one inch Professor Bucky has applied the same method to models of the various strata in a mine shaft. The stroboscope helps to find at what point of stress the roof will begin caving in.

At the Cambridge, Massachusetts, laboratories of the General Radio Company, manufacturers of the stroboscopes most commonly used in industry, is a stroboscopic clock by means of which time intervals can be read to two ten-thousandths of a second. This clock, indispensable for radio frequency calibration, consists of two synchronized dials. The left-hand dial, like an ordinary clock face, has a minute hand, an hour hand, and a second hand. The right-hand dial has only two hands The shorter one rotates around the dial once a second, the longer, ten times a second. This is too fast for the human eye to observe But the stroboscope easily freezes the motion of the faster hands, making possible a reading of time in seconds, accurate to four decimal places

THE stroboscope was born in 1832. Like so many inventions, it was discovered by two men, Stampfer of Vienna and Plateau of Ghent, quite independently of each other. But apparently both men were inspired by some investigation of Michael Faraday's who, in turn, had become interested in the phenomenon of "persistence of vision" through observations made by Peter Mark Roget, British physicist and compiler of the famous "Thesaurus" Plateau called his device a "phenakistoscope." Stampfer had a less unwieldy name — stroboscope — which stuck Composed of two Greek words, it means, roughly, "whirling watcher"

THE first "whirling watchers," disks with slots cut into them at regular intervals, were soon used to interrupt a steady beam of light Professor Edgerton's stroboscope is a logical advance made with the aid of modern electronics — a practical, inexpensive instrument to interrupt the light itself at its source As often happens, his development of the stroboscope to its present high point was a by-product of other research Professor Edgerton, in studying the "hunting" and irregular motion of synchronous motors, needed a more reliable and penetrating extension of the feeble human eye than was to be had at that time The work done since, by him and his associates, Messrs Germeshausen and Grier, has startlingly widened the horizon of man's knowledge

What about wind turbulence and how well designed are the blades of an electric fan? Streamers of smoke blown through the fan give the answers to designers when photographed "still" under the light of a stroboscope

Coming soon An article that answers some puzzling questions as to the serious shortage of diamonds that is hampering Nazidom's war efforts, and the optimistic, but baseless, promise of an adequate supply from the Urals in Red Russia The discussion is an absorbing one about "worker" diamonds and their elegant and romanticized cousins—or should we say brothers? Count this as one of the inside war stories we promised, other fine ones are coming
—The Editor

The new, portable stroboscope valuable in many industries, does a regular job of "stopping" motion of the high-speed cutters of an electric shaver so that they may be adjusted. Photograph courtesy General Shaver Division, Remington Rand, Inc.

Winners in the Fourth Annual Scientific American Photography Contest

The judges (left to right) Ivan Dmitri, Robert Yarnall Richie, and McClelland Barclay, eliminating photographs in the final judging of our latest contest

AMATEUR photographs by the hundreds deluged the editorial offices of Scientific American as the Fourth Annual Photography Contest drew to a close. From all over the world they came, forming in the aggregate one of the finest displays of amateur work in this field that we have ever seen. When the cream of these pictures had been selected in the semi-finals and hung on exhibition, they were viewed by representatives of the leading manufacturers of photographic equipment and accessories. Blase though this group might be expected to appear, they expressed the deepest interest, several going on record in the following composite manner: "Outstanding among displays of amateur photography. The pictures here are far above the average."

Justly proud were we to feel (and see for ourselves) that there are among readers of Scientific American such a large number of advanced amateur photographers who could turn out fine examples of work. Even more proud must be the winners whose names appear on this page. They were up against stiff competition and the fact that their pictures survived the gruelling examination of the judges is proof of outstanding excellence.

Because of the large number of prize winners, and limited magazine space, we are not reproducing the prize winning pictures this month. We have, however, listed, following their names, the cameras, film, and enlarging papers used by the major prize winners. First and second prizes in each division were solid gold Longines watches listing at $250 and $125, respectively. Third and fourth prizes in each group were Federal enlargers. In addition to these prizes, and 15 honorable mention awards each consisting of a one-year subscription to Scientific American, a special prize of $50 cash was presented to Nathaniel Field, Brooklyn, New York, by the Federal Stamping and Engineering Company, for the best photograph made with a Federal enlarger entered in the contest.

Watch for announcement of the 1940 Scientific American Contest.

DIVISION 1

1st Ladislas Freeworth, Budapest VII Hungary

2nd Alvin W. Prasse, St. Louis, Missouri, Voigtlander Bergheil, Agfa Super-Plenachrome, Agfa Projection

3rd Thomas E. Benner, Urbana, Illinois, Speed Graphic, Agfa Superpan, Eastman Portrait

4th Elise Voysey, Bayville, L. I., New York, Super Ikonta B, Agfa Superpan, Velour Black

HONORABLE MENTION

Kenneth Mazawa, Chicago, Illinois. Joseph G. Danley, Trenton, New Jersey. Wm. Carlson, Morris, Illinois. Ladislas Freeworth, Budapest VII, Hungary. Rev. F. M. Wetherill, S. T. D., Philadelphia, Pennsylvania.

DIVISION 2

1st. A. H. Timmons, Glenwood Landing, New York; Zeiss Ikonta, Agfa Superpan Press, Brovira Kashmir Hard.

2nd. Wm. H. Keaton, Wheeling, West Virginia; Voigtlander Brilliant, Eastman Super XX, Defender Velour Black.

3rd. James Liccion, Rochester, New York; Bantam Special, Eastman Super XX, Kodabrome.

4th. Henry Reid, New York, New York; Leica, Agfa Infra-Red, Kodak Royal.

HONORABLE MENTION

Henry M. Blatner, Albany, New York. Alvin W. Prasse, St. Louis, Missouri. James Liccion, Rochester, New York. Thomas E. Benner, Urbana, Illinois. Harold B. Stoddard, Westfield, New Jersey.

DIVISION 3

1st Harry B. Forse, Victoria, B. C. Canada, Kine Exacta, Agfa Supreme, Agfa Portrait

2nd Charles W. Fairbanks, Rochester, New York, Contax II, Agfa Supreme, Kodabrome

3rd Joe Larber, E. Lansing, Michigan; Leica, Eastman SS. Pan, P. M. C.

4th Stephen F. Harris, Dover, Massachusetts, Auto-Graflex, Eastman SS Pan, P. M. C.

HONORABLE MENTION

Robert S. Holzman, New York, New York. Harry B. Forse, Victoria, B. C., Canada. Zia Qadri, Los Angeles, California. Ben B. Hains, Ogden, Utah. Nathaniel Field, Brooklyn, New York.

ALGOL'S ECLIPSES

By HENRY NORRIS RUSSELL, Ph.D.
Chairman of the Department of Astronomy and Director of the Observatory at Princeton University Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington

"WITH the exception of the Sun, probably no star has been so intensively studied by astronomers as the 'demon' star Algol" So begins the latest discussion of the system—just published by Dr John S. Hall of Amherst.

Algol was the first star to be suspected, on the ground of observation, to be really a binary. Before Herschel had observed orbital motion in telescopic double stars, Goodricke, in 1782, discovered that this star lost the greater part of its light at regularly recurring intervals of two days and a little less than 21 hours, and pointed out that this might be due to eclipses by an enormous planet revolving around it

Fully a century later, Pickering, having developed instruments for accurate photometric measures, showed that the changes in light agreed precisely, and in detail, with those predicted by the eclipse theory, and so settled the matter beyond question

Since then, several long series of precise observations have been made The first of these, by Stebbins in 1910, showed half way between the main eclipses a small but definite secondary minimum, due to the eclipse of the companion by the principal star, and proving that this was not a dark planet but a star shining on its own account, though but feebly compared with the other. It was in this work that Dr Stebbins—then a junior member of the faculty—was asked to explain a requisition for "2000 pounds of ice to be used in astronomical observations" His photometer, now superseded, would work only when the sensitive cell was kept at a uniform low temperature Eleven years later, with a still more accurate photo-electric photometer Stebbins obtained a light-curve of exemplary accuracy and completeness, and one might have supposed that no more observations were needed, except to keep track of possible changes in the period and the like.

But the photo-electric cells of 1921 were sensitive only to blue and violet light (of an average wavelength of 4500 A). It is now possible to make cells in which the active surface consists of cesium oxide, which are highly sensitive to the red and even the infra-red It is with such a cell that Stebbins and his colleagues made the observations of the reddening of the stars by absorption of light in space, of which we spoke last month, and with similar ones that Dr Hall has worked—first at the Sproul Observatory and later at Amherst. In this way observations were secured with infra-red light, of wavelength 8660 A—quite invisible to the eye

The figure, which is here reproduced by courtesy of *The Astrophysical Journal* shows what a wealth of new information comes from the new observations The lower curve is Stebbins' for blue violet light, the upper, Hall's for infra-red—differences in magnitude being shown respectively at left and right, phase in fractions of period across the bottom The dots represent the observations—each one an average of many settings—and define the course of both curves with accuracy

The principal features—the deep primary minimum and the shallow secondary—are visible in both curves. Both are round-bottomed, with no constant phase, showing that the eclipses are partial. But, with infra-red light the secondary is much deeper and the primary a good deal shallower

The meaning of this is plain. At the middle of the primary eclipse the fainter star *B* hides from us a part of the brighter star *A*; at the other eclipse *A* hides a part of *B*, and this eclipsed area is the same, no matter what kind of light we use for our observations. The deeper secondary minimum thus means that *B* gives out more infra-red light, in proportion to the violet, than the average of the two stars, and the opposite is obviously true for *A*. Hence the two stars are of different colors, and *A* must be hotter than *B*. Many similar cases have been known, but the accuracy of the present observations, and the great difference of wavelength, make them noteworthy.

The loss of violet light at the principal eclipse is 65 percent, and at the other 3 8 percent The orbit is circular (as is shown by spectroscopic observations) Hence the real distances of the stars from one another are the same at the time of the two eclipses, and the eclipsed areas are the same It follows that, per square mile, star *A* gives out 17 times as much violet light as star *B*. In the infra-red, the light losses are 50 percent and 11.2 percent, and the ratio of surface brightness is 4½.

From these data, we can find the temperature of one star from that of the other. The spectrum of Algol, that is of star *A*, is B8—with faint helium lines. Dr. Hall adopts 15,000 degrees for its "color-temperature" and finds 5900 degrees for star *B*—slightly hotter than the Sun. The "enormous planet," though undoubtedly enormous, is therefore far from being a dark body but is brighter than the Sun itself

But there is much more to be learned from the light-curves It is obvious that, between the eclipses, they are not horizontal, but run up toward the secondary eclipse. This phenomenon, discovered independently by Dugan and Stebbins in different stars, is also easy to explain Star *A* is very bright and hot, its powerful radiation heats up the near side of star *B*, and makes it brighter than the far side At the time of primary eclipse, or just outside it, we see the side of *B* which is remoter from *A*—that is, the darker side, near secondary eclipse, we see the brighter side This "reflection" effect (which ought properly to be called heating effect) is decidedly greater in the infra red than in the violet The whole range in brightness, due to it—that is, the difference in light between the bright and faint sides of star *B*—is found to be 6 9 per cent of the total light of the system in the first case, and 3.0 percent in the second These amounts must be subtracted from the light of the bright side of *B* (which is the one which undergoes the secondary eclipse) to find that of the fainter side We do not yet know the former—only that fraction of it which is eclipsed; later calculations show that this fraction is close to 50 percent. The bright side of star *B* therefore gives out 7.6 percent of the whole amount of violet light, and 22 4 percent of the infra-red, for the dark side these become 4.6 and 15 5 percent, that is, 61 percent and 69 percent as much as for the bright side. The dark side is therefore somewhat redder, and must be cooler. Hall calculates a temperature of 5600 degrees instead of 5900 degrees. Only very precise observations could have detected this from an effect nearly drowned out by the powerful light of star *A*.

A very close inspection of the figure will show that the curves between eclipses bulge up slightly in the middle This effect—which is much more conspicuous in some other systems—arises because the stars are pulled out by each other's tidal attraction and become

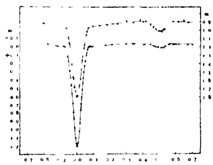
slightly egg-shaped, with their long ends pointing toward one another. Half way between eclipses we see them broadside on, and they look brighter. In the present case the stars are rather small compared with the distance between them, and the ellipticity is small, the difference of the long and short diameters being 1.9 percent, according to the violet observations, and 2.0 by the infra-red. Even this tiny difference makes sense. Star B is less massive than star A, and should be more distorted than its companion. The observed effect is an average between the values for the two stars, taken in proportion to their light. Since B is brighter in the red, it should affect the average more. An accuracy even surpassing that of the present admirable observations would be necessary in order to find out in this way just what the shapes of the separate stars were.

The question of the actual size and brightness of each star remains to be settled. With such fine light-curves, this should ordinarily be an easy matter. We first "rectify" the curves so as to eliminate the heating-effect and the ellipticity (which is easy). Then—to understand the principles involved—we could proceed as follows. Begin by guessing at the light of star B, say 25 percent of the whole in the infra-red. Then star A gives 75 percent, and at the middle of eclipse 50/75, or 67 percent of the light of this star is obscured, while for star B this fraction is $\frac{11.2}{25}$ or 45 percent. Assuming that the star disks are uniformly bright all over, this eclipsed area is 67 percent of the disk of A, and 45 percent of that of B. Hence the fainter star B must be the larger, and have 1.22 times the radius of the other.

IF we know the relative size of the stars, and the maximum percentage of eclipse, an easy calculation (with the aid of tables prepared for the purpose) gives the form of the whole light curve, if we are given the width at the point where half the maximum amount of light is lost. This can be read from the observed curve. If the calculations are repeated, with different values of the assumed brightness of B, we will get different calculated curves. All will agree with observation at the half way point, and at the bottom, because they were made to do so; but some will be narrower in the lower portion and wider at the top, than others. Comparison with the observations shows what value of the light of B fits the facts. The actual process of calculation is less clumsy than this but based on the same principles.

It ordinarily leads to quite definite results; but in just this one case of Algol there is an unusual complication. Spectroscopic observations show, as was to be expected, that star A is moving in a circular orbit about the center of gravity of itself and B. But long-continued observations have proved that this close pair is itself a part of a wider one, with a period of 670 days— revolving in a slightly elliptical orbit about the center of gravity of itself and a distant companion C.

Neither star B nor star C is bright enough for its spectrum to escape being drowned out by that of A in the violet region where radial-velocity observations have been made—even when this star is partially eclipsed. But this means



Light curves of Algol's components

only that C does not give more than 10 or 12 percent of the total violet light of the three together—and possibly more of the red light.

We have now a new uncertainty in our calculations. Assuming, for example, that C gives 10 percent of the total infra-red light, and B 25 percent, as above, we have 65 percent left over for that of A, and, proceeding as before, find that 77 percent of the area of A is eclipsed and that B has 1.31 times the radius of A. By the same method as before, we can find a new value for the brightness of B which will give a good fit to the observed light-curve. It turns out that whatever guess we make about star C, we will get practically the same calculated best-fitting light-curve, and will have no way of telling which of our guesses is the best.

We have still one recourse, of a different kind, depending on the masses of the stars. We cannot calculate the masses from the spectroscopic data unless we know how far stars B and C are on the other sides of the centers of gravity of their respective orbits; but, at least, we know a *relation* between the masses—which with due apology to our readers, it appears easiest to express by means of algebra. If A, B, C now represent the masses of three stars (with the Sun's as unit) the data for the close pair give

$$B^3 = 0.026\ (A + B)^2$$

and for the other

$$C^3 = 0.059\ (A + B + C)^2$$

(Here it is assumed that the orbit of the wide pair, like that of the close pair, is nearly edgewise to the line of sight.)

If we can find the ratio B/A in any way, the first equation gives their values, and the other then gives C.

Now there is, on the average, a close relation between the mass and luminousity of the stars, and, from the ratio of brightness of any two, we can estimate the ratio of their masses. On this basis, A should be about twice as massive as B. Setting $A = 2B$, we find at once $A = 0.47$, $B = 0.23$, $C = 0.42$. This will not do, for several reasons. First the actual brightness of Algol (star A) is about four times that of Sirius, and we should expect it to be more massive than Sirius, that is of at least three times the Sun's mass. Secondly, if C is almost as massive as A, it should be about as bright—which it certainly is not.

HALL adopts $A = 1.6$, which makes $B = 0.48$, $C = 0.79$. Star C should then give one sixth as much light as star A, and the spectroscopic observations are explainable. But the brightness of star B, calculated from its mass, comes out only a quarter of the observed value. There is something queer about one of these three stars. The assumption that star B is too bright for its mass appears to be the most reasonable one to make, for we know that such things actually happen.

The bright star, Zeta Herculis, for which we have accurate data, has very nearly the Sun's mass—or slightly less—and almost exactly the same spectrum and color as the Sun. We should expect it to be a little fainter than the Sun, but it is four times as bright, and must have about twice the Sun's diameter.

Stars of this sort appear to be moderately uncommon. But the best place to look for them is among the large faint companions of eclipsing variables. Sirius, for example, is probably 1.8 times the Sun's diameter. If it had a close companion just like the Sun, an eclipse by this would at best be annular, and cut off about 35 percent of the light. But a companion of the same mass and spectral type, like Zeta Herculis, could eclipse it totally, and cut off 85 percent of the combined light, producing a conspicuous eclipse when the other would stand a poor chance of being discovered.

When we hunt for eclipsing variables we are making a special search for large companions of low density, whether we realize it or not. So it is not remarkable that we find them.

If only the spectrum of either star B or star C could be observed during the principal minimum, a great deal more could be found out about Algol. Spectroscopic observations in the red might help—and would be worth a good deal of trouble to make.—*Princeton, December 5, 1939.*

Double-check by engineers who are laying the groundwork for new maps for motorists by driving over the area with government topographical maps

SEVEN MILLION MAPS

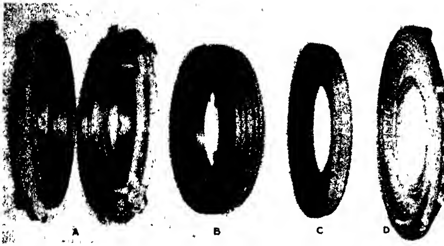
By ANDREW R. BOONE

USING United States Government topographical maps as a base, engineers for the Automobile Club of Southern California chart streets and roads by actually driving over the territory. Driving thousands of miles monthly, they keep up to date 1000 maps and help make available 7,500,000 maps each year to motorists. As they drive, they also consult California highway, county engineer's, and United States Forest Service maps. In the laboratory, scale of the base map is changed by a pantograph to conform to size of map desired. The original layout is first made on tracing paper by pencil, and from the layout an ink tracing is sketched. Following completion of the tracing, a photographic negative is made, and a positive black-line picture printed. The black-line is then mounted on pressed wood. After printed lettering is pasted at the appropriate positions, the map is photographed and reduced in the form of a wet-plate negative to printing size. A color separation is made on this negative from which various lithograph color plates are produced, at the same time another print is made from the wet plate on sensitized zinc, on which mountain relief is sketched with wax crayon. These plates are now made ready for printing the completed color map.

Preparing wet-plate negative from which lithograph plates are made

After all available data are collected, the completely corrected map is put under a pantograph and redrawn to a new scale that will be in keeping with the motorist's finished road map

Proofs of type-set wording are trimmed to size and pasted in place on a large-scale black-line print that has been mounted on wood



Tire molds, made by usual engraving process, require over 165 man-hours to produce


Sections of electro-formed tire molds before and after being backed with cast aluminum. Such molds are harder than older types and are excellent conductors of heat

Molds By Electro-Forming

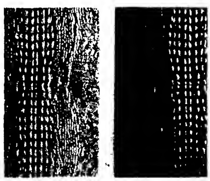
RESEARCH, designed to find a process for the cheaper production of tire molds, has resulted in the development of a method of producing a variety of elaborate articles hitherto prohibited by tool costs. The new process, known as Ekko, comes from the laboratories of the United States Rubber Company, and has now been made available to industry at large.

The Ekko process produces molds and dies by electro-forming iron against a pattern it is desired to reproduce. Electro-forming is the same as electro plating except that deposits up to ½ of an inch thick are produced instead of the 1/1000 to 2/1000 of an inch thickness of metal applied by the usual electro-plating processes. Electro-plating is used for decorative purposes or to provide corrosion resistance, while electro-forming is used to build up a mass of metal.

THE electro-formed mold, with which is to be made tires or other products can be made at a considerable saving over the cost of an engraved mold. It requires considerably less labor and, in the particular case of tire molds, finished forms can be mounted in what are known as "watch cases" already available from old molds. A further advantage is that the iron deposited by the electro-forming process is 99.98 per cent pure and is substantially free from porosity. It is about 50 percent harder than cold-rolled steel but can be softened to the normal value of pure iron by annealing or so hardened by carburizing that it will scratch glass. It has a heat conductivity nearly twice that of cast iron or steel—a valuable property for heat molding where a high rate of heat transfer is desirable.

In making an electro-formed mold of a tire, a pattern or matrix is first obtained from an engraved mold. An adjustment is made to provide extra metal where the new mold must later be cut in two. Then the pattern is made an electric conductor by dusting it with powdered graphite and polishing it vigorously with a light brush. Following this, it is placed in the electrolytic bath and electro-plated. The essential difference between this and ordinary electro-plating as indicated above, is the much greater length of time the plating is continued.

Many types of materials such as wood, glass, plastics, and so on, not attacked by the plating bath, may be used for making the pattern upon which the mold is to be deposited.


The embossing trade can also use the new process for making such molding plates as that shown at left above. It was made on the imitation leather pictured above at right

One of the first applications of the electro forming process to other than tire molds was the preparation of a sponge rubber hand for a young girl who had been in an automobile accident. This was made at the suggestion of a sculptor friend of the young girl because of a feeling that the usual type of artificial arm would be highly unsatisfactory with long sleeves as well as with short ones. The sculptor prepared a model of the missing hand in plaster of Paris, correct in every detail. This reproduction was used as a pattern to electro-form an iron mold, which was then used to mold a reproduction of the hand in sponge rubber. This artificial hand provided lightness and resiliency, was tinted to match skin coloration and required no straps or braces but permitted the wearer to open doors and drive a car.

Since the successful preparation of the mold for the sponge rubber hand, which indicated the desirability of electro-forming in the rubber industry, the Ekko process has been successfully applied in the plastics, glass, embossing, and metal stamping industries.

The electro-formed mold for a hand, described in text, is shown in two parts in picture at right. The finished hand slips on the stump of the girl's wrist

Engineering In Dentistry

Dentists' Main Problems are to Get Strength Plus Resiliency . . . Add to This: Art . . . Precious Metal Alloys and New Porcelains Meet Needs of Dentists

By A. W. JESSUP

"WHAT! Engineering in dentistry? Absurd!" So might most of us speak

But there is engineering in dentistry today along with metallurgy, ceramics, and art. It is quite probable that the dentistry of tomorrow will require the same combination, although many hope that it will be replaced by preventive measures Some of the best minds in the profession are concentrated on efforts to attain this much desired end, yet there are mysteries that are just as imponderable today as they were hundreds of years ago

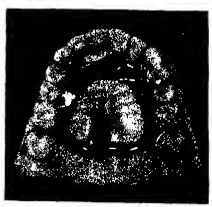
Despite the fact that dentistry can be traced back to long before the Christian era, the present technical and scientific advances have been very recent. A hundred years ago dentistry was not very much different from that practiced by the Etruscans over 2500 years before. The oldest denture in existence was found in the jaw bone of an Etruscan who lived before the Sixth Century B C. It consisted of four loose teeth secured by a ribbon of gold to the firm teeth on each side of the cavity. Often the teeth in these crude dentures were not human teeth but were carved from the tusks of animals

For the most part, early Nineteenth Century restorations were similar contraptions of loose human teeth, wire, and springs. Solid plates were being carved from ivory but were little, if any, better and were much more expensive An ivory set belonging to George Washington is now in a museum Some work was then being done in Europe with porcelain teeth set in gold bases, but centuries-old processes and designs were most common

Much of the transformation from these clumsy devices to the durable, comfortable, and good looking dentures of today is due to the application of engineering to dentistry As the engineer builds a great river bridge, so does the dentist of today make a restoration for the human mouth He follows the two engineering steps of design and selection of materials, aiming to secure the greatest all around efficiency from the most suitable materials Poor design and inferior materials mean failure for both engineer and dentist Instead of fastening loose teeth in the mouth as of old, the dentist plans a denture that will be strong, long wearing, comfortable, and compatible with the wearer's natural appearance All of these are important.

The first step for bridge and denture building is design For the dentist, the design problems are complex and exacting He is under greater restrictions as to the size, shape, and weight of his structure than is the engineer. Each restoration, furthermore, is an entirely new job, for no two human jaws are exactly alike The denture must be strong, for the forces exerted by the jaw, in masticating, range from 25 to 275 pounds with different individuals. The dentist must reinforce those points that have to bear the greatest load and shift some of the pressure to less taxed parts

Ancient and modern dentures. Above is a crude Etruscan affair of gold and carved animal tusks, dating from 500 B. C (Courtesy the book "Geschichte der Zahnheilkunde") At the right and below are views of an elaborate modern denture, with a model of the mouth it is to fit. The latest alloys and porcelain teeth were used to make this one



The patient's comfort and physical appearance depend on proper designing of the denture to fit the oral cavity perfectly It is easy to see how a too-large or badly shaped restoration would be painful and would detract from a person's natural appearance.

In recent years, the demand for appearance has become almost as important a requirement as comfort and serviceability. This is true not only of people who are continually in the public eye but also for those in ordinary walks of life as well. Hence our dentists have so perfected their processes that most dentures improve the wearer's looks Also contributing to inconspicuousness are smaller artificial teeth, and precious metal alloys and porcelains which match the natural coloring of mouth tissues and enamel Dental science has advanced so far that the fulfillment of the esthetic desire does not necessitate the sacrifice of the other desirable qualities in a restoration

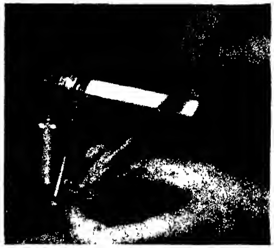
All of the dentist's labor on design would be useless if he selected inferior materials for his dentures Dentists of the past have used wood, wire, tacks, and both human and animal teeth for restorations Today, they turn to the many precious metal alloys and to porcelain Various combinations of platinum, palladium, and gold meet the many present day needs The premier requirement of a dental metal is an ability to undergo the stresses of mastication without permanent bending or loss of shape. To the patient, this retention of form while in use means a long-lived, comfortable restoration. The clearest examples of this property are the clasps by which partial dentures are secured to the natural teeth These metal clasps are sprung over the contours of the teeth and, if made of an inferior alloy,

would soon be spread and bent out of shape by the pressure of insertion and removal. Frequent readjustment and much discomfort and inconvenience would be the price paid by the patient

What about the natural teeth still in the jaw? Nothing must be done to harm them and cause their early loss The dentist, therefore, at every turn selects materials that will not injure them The alloys must be hard enough to wear well, but must not be so hard that they will abrade the adjacent and opposing teeth Wear and injury would be rapid if materials harder than the natural enamel were used Since dentures must absorb the stresses of mastication, resiliency, as opposed to rigidity, aids in preserving the natural teeth.

As temperature has a marked effect on the sensation of tasting, conductivity in full dentures has to be compatible with that of the natural teeth and mouth tissues, otherwise the patient's dietary habits would be violently disrupted Ability to discern temperature of food and drink at near the natural rate has the added advantage of helping prevent serious mouth burns

While the dentist was perfecting his dentures, he was demanding better and better materials from the metallurgists and ceramicists. As a result of their mutual co-operation, the producers of precious metals created alloys to meet the increasingly rigid requirements Further aid came from the Bureau of Standards which began research in 1919 that resulted in numerous specifications for dental metals. Thus the dentist can obtain alloys which accurately fulfill his various requirements



Photos, except Etruscan denture, courtesy J M Ney Co

Dentures are made by what is essentially the lost-wax process of casting. In the first step, *above*, the denture is formed and sprued (provided with a gate to receive the molten metal) in wax on the model that was made in plaster from a plaster cast of the patient's mouth. Then, *right, above*, the wax pattern is removed from the model and painted with investment, a dense, plaster-like material

The wax pattern with painting completed, *above, left*, is placed, point down, in the casting flask *above, center*. The top of the flask ready for casting is shown at *right, above* This is placed in a centrifugal casting machine, the platinum-palladium-gold alloy is melted with a gas and air torch in a cup before the sprued mold, and the machine is whirled to throw metal into all parts of the mold hollows left by melted wax.

At *left* is the rough casting and at *right* is the completed denture after trimming away the sprue metal and any minute roughness, and then polishing the piece

METALS have been used in dentistry as far back as there is record Until the middle 1800's, gold retained its place as the premier dental metal To procure a harder and stronger metal, small amounts of silver and copper were alloyed with gold Later additions of platinum and palladium were found to give even more desirable physical properties. Experimenters, combining platinum with gold in 1875, found a 12 per cent platinum alloy had exceptional strength properties. In more recent decades dental metallurgists investigated palladium for dentistry. It does not have the same weight and cost-limitations as platinum, and may be used in much larger quantities as an alloying element with gold.

In the natural course of searching for the ultimate alloys, dentistry will probably never stray very far afield from the use of the precious metals: platinum, palladium, and gold. Combinations of these meet all of the dentist's requirements for strength. Moreover, all of the precious metal alloys have a hardness compatible with the natural enamel, and a suitable resiliency.

The new alloys and porcelains make possible smaller teeth that previously were not strong enough to be practical Porcelain has been developed on a mass production basis and, from stock molds, more than 90 percent of the natural teeth can be matched perfectly for size and shape

Besides being an engineer, the dentist is also an artist. The recent esthetic demands have caused this Cutting down the size of artificial teeth was a big stride toward the fulfillment of this desire. Teeth, furthermore, are made in shapes to match the three facial forms—square, tapering, and oval. Also contributing to denture appearance is color. Precious metal alloys are available in all shades from platinum-white to yellow for inlays, crowns, dentures, clasps, and wire. Nearly all shades reflect the natural color of the mouth and are therefore less noticeable. Porcelains are also colored to match the natural enamel

Not only have rapid strides been made in the scientific aspects of dentistry, but also in the training of the practitioners themselves Webster's first American dictionary published in 1828 defined the dentist as "one whose occupation is to clean and extract teeth and repair the loss of them" What it failed to reveal was that he was also occupied with the business of cutting hair and shoeing horses Today they must undergo at least six years of intensive university training—two years pre-dental and four years in one of the more than 50 accredited dental colleges in this country.

Dentistry is no longer a hit-or-miss business. When we have need for dental work, we can sit with confidence in the dentist's chair—confidence because we know that he knows what he is doing, that he has the best materials and that he won't spoil our good looks. This is a far cry from the operations of barbers and blacksmiths of a century ago.

Spare Parts

By G. H. ESTABROOKS
Head of the Department of Psychology at Colgate University

We are all familiar with certain losses which the human can sustain and still live. An arm, a leg, even both arms and both legs may be amputated Eyes are very important to happiness but not to life, while, of course, the loss of an ear is a mere trifle If your teeth don't suit you, get a new set, while the disappearance of one's hair is merely "a sign of intellectuality" Tonsils and adenoids are only encumbrances, while our old friend the appendix is a new version of the white man's burden.

All these possible alterations we more or less take for granted, but when the surgeon opens up the body and starts tinkering with our "innards," then we feel he is treading on very dangerous ground And he is Yet, for all that, large portions of our internal anatomy can be removed, altered, or replaced and we are still a going concern

Man is like your auto—his engine will keep running after you have removed a whole carload of mud guards, hoods, body parts, even tires To be sure, it may be a sorry looking wreck with which you end, but the essential life-producing engine, both in auto and in man, will still be turning over even after the wrecker had done a pretty thorough job Interfere with any vital part of the engine, however, and no matter how beautiful your car—or your human—it is dead on the instant Modern surgery gives us some fascinating glances at the human engine, revealing to us many "spare parts," once considered essential but without which the human can now function very nicely

It is, of course, absolutely necessary that we have a supply of air Without the oxygen contained in the air, the human engine simply cannot run Nature, foreseeing trouble in this area, has given us considerably more lung capacity than we really need We can get along very nicely on one lung or even half a lung, provided we don't go in for athletics.

Man has learned some interesting tricks in handling lung diseases Tuberculosis, for example, is a very dangerous disease, best treated by giving the involved part complete rest Then your body handles the bug at its leisure But how can you put a lung out of action? There are several ways One is to literally pump you up Immediately outside the lung is the pleural sac, made up of two very smooth surfaces which slip over each other every time you breathe. Sometimes these surfaces become irritated and you have pleurisy, which can be very painful So, when the tuberculosis specialist wishes to give one of your lungs a holiday, he punctures this pleural sac with a large needle and pumps it full of nitrogen, using this gas because of its inert nature This compresses the lung so that it cannot work The nitrogen will be absorbed only slowly by the tissues, but it is absorbed, for all that, hence every two or three weeks you have to report back and get inflated *No*—you *can't* insert a permanent bicycle valve and pump yourself up with free air

Another way in which this lung can be given a rest is to cut the nerve which supplies it Then the lung is literally paralyzed, and if the situation is handled properly this nerve will grow back again and the lung will be restored to activity at the end of, say, six months Still another, and much more dangerous way of handling the situation, is the technique of removing an entire lobe of the lung This is a major surgical operation in which the doctor has to cut through the ribs, the chest wall, and disconnect part of the lung itself When you realize how great is the blood supply to these parts it is a wonder that death from hemorrhage is not the invariable result However, this operation is used only as a last resort and modern surgery is making immense strides in controling just such situations

One of the most curious of all methods in modern medicine is one in which they literally cut your throat in order to make you more comfortable It sometimes happens that certain nerves supplying the larynx or "voice box" become paralyzed, resulting in a disagreeable situation wherein breathing is very difficult The intake of every breath requires a gasp but, strange to say, you can breathe out or talk with perfect ease, once you get the air into the lungs. So the surgeon nonchalantly cuts your throat He bores a neat little hole into the windpipe below the larynx and you breathe in through this The air also passes out by way of this route—unless you want to talk, then you hold a handkerchief over the hole, thus forcing the air through the vocal cords, and you talk as well as ever Generally this hole is concealed by a neck band or other covering You could actually talk to a person who had had such an operation without noticing the injury or suspecting why he kept his handkerchief pressed to his throat.

At times the surgeon finds it necessary to remove the entire larynx Cancer may render it useless and the disease might also spread to other nearby structures, so he cuts it out and installs one made by Western Electric Not quite as good as the original, to be sure, but it makes speech possible and you certainly could never contract laryngitis in that contraption

The so called "artificial lung" is not a spare part It is just an ingenious machine for supplying artificial respiration—for forcing you to breathe when the lungs become paralyzed, as in infantile paralysis Given time nature may —or may not—be able to repair the paralysis resulting from this disease By "time" nature means from three to six months, a long period to go without breathing The artificial lung manipulates the pressure on your chest so that air is forced into and out of the lungs If these recover from the ravages of infantile paralysis, you can be taken out of the "lung", if not, it is only a matter of time before death ensues Many people have literally been snatched back from the grave with this spectacular device

Modern medicine can do a great deal with the breathing apparatus, but nature flashes a bright red warning light when we approach the heart. The individual's life is in danger when we even touch this complicated and beautifully coordinated blood pump, while only the most skilful surgeon dares operate Even so, his invasions are confined to the surface of the organ Instant death would be the result of any such liberties as he might safely practice with the lungs To be sure, we may tie off an artery or even remove a vein, and so modify circulation, but the heart we must respect Even this matter of tying off an artery is not so simple If, in an automobile accident, you cut the great artery leading down your leg or arm, the surgeon will probably amputate irrespective of bone conditions You have cut off the blood supply, which may easily lead to gangrene, and just about anything is preferable to this form of tissue clot.

Of course, in one sense of the word, your blood is really a spare part To be sure, you cannot live without It, but the doctor can remove a couple of quarts of blood without doing you any particular harm This he can then inject into the veins of a very sick patient, who for

The Human Body Contains a Remarkably Large Number of Parts Without Which it Can Survive or Even Function Normally . . . Some are Duplicates

one of many reasons may need blood, and so save his life He has to be very careful that you are in the same blood group as the recipient and, needless to say, must exercise every precaution that you are not suffering from any disease, such as malaria or tuberculosis, which can easily be passed on by blood transfusion But there are less obvious dangers I just noticed that a case of hay fever has been thus transmitted Probably all these allergic conditions act thus, while immunities, even susceptibilities to certain other diseases, may be passed along by way of the blood route Of more interest is the trick of inserting glucose directly into the veins Sugar is the fuel on which our engine runs and this insertion of it is of tremendous importance in certain cases where the patient has not the time or the ability to take in the food by the stomach

The endocrine glands are now almost being relegated to this spare part rôle We cannot do without them but we can prepare their secretions outside the human body and inject them should the gland become diseased Diabetes was once practically a death sentence It is caused by the absence of insulin secreted by cells in the pancreas We now manufacture this substance from animal glands and the diabetic can be healthy and happy with his hypodermic needle, if he just won't overdose or underdose If he does, then insulin shock or diabetic coma offer a quick and painless road to eternity The deadly Addison's disease, caused by a deficiency in the cortex of the adrenal gland, we now control by the recently discovered "cortin" The thyroid gland can cause any condition from idiocy — the cretin — up to a maniac state of insanity—which often accompanies exo-pthalamic goiter. The cretin we can at least help by injecting thyroxin and in the maniac state caused by too much thyroxin, we remove a large part of the gland.

In certain rare cases man loses the four little parathyroids in the neck This was almost invariably fatal until a Canadian discovered an injection which keeps the patient alive These little glands are literally spare parts If the individual can live six weeks after their removal, the body will compensate for the loss and he is healthy without either the glands or their secretion. Several of the glands, however, still hold their secrets We cannot prepare the secretions from the pineal, thymus, or pituitary. One obvious solution to this gland problem would appear to be that of grafting, but grafts have been quite unsuccessful except in certain cases associated with the sex glands and these are questionable

Plastic surgery of one kind or another gives us startling examples of interchangeability in body parts These days of automobiles yield some bad face wounds and here the plastic surgeon does his most spectacular work A new nose bridge, jaw, or other facial part needs only live bone tissue and proper modeling for a graft — and any of us can spare a rib So the surgeon converts part of a rib into a nose bridge borrows a few square inches of skin from your chest to make an upper lip or a cheek does a very neat job of sewing things up, and you'll pass at tea in any drawing room Grafts of skin, bone, and muscle are also possible in other parts of the body, ravaged by disease or accident

FROM the biologists' laboratories we are getting some very fascinating hints as to possible developments along these lines The biologists have found for example, that they can graft eyes in the case of the salamander The new eye grows into place and apparently functions quite as well as the old With insects they can even take developing eye tissue, shift it to a totally different part of the body and get an eye on abdomen or tail One enterprising biologist has transferred heads in insects, even to different species! Needless to say, such experiments have no practical value whatsoever to the human - but give us time In all great centers of research humanity is literally following Aristotle's great dogma "The highest study of man is man"

Some of the surgeon's most spectacular work in this spare part field is found in operations on the food tract We regard the stomach, for example as essential to human life. But you can get on very nicely without a stomach You may have to watch your diet a little more carefully or eat at different intervals than you do at present, but when your stomach becomes cancerous or the walls become weakened with gastric ulcer, the surgeon may take the whole thing out and call it a day. The food then enters the small intestine direct, without this stomach stop-over The main task of this organ was to break down proteins, a job which is also done in the intestines, so it merely means that certain intestinal juices have to work overtime.

Similarly, we find that you can lose a yard or two of small intestine with no particular discomfort The whole of this 30 foot organ is used for digestion, that is, to break down food substances into very simple combinations which can then be absorbed through the intestine walls, thus entering the body proper The small intestine is really more important to digestion than is the stomach, but there is a lot of it So a few odd yards don't really count too heavily

And the same applies to the large intestine, the colon Here, waste from the food is stored prior to being ejected from the body A certain amount of absorption takes place, but the colon is also a potential seat of infection It is an easy matter for this food waste to start decaying and this may quickly infect the intestinal wall, especially if its free passage from the body happens to be blocked So, when this condition occurs the surgeon may remove the entire colon having the food leave the body directly from the small intestine

We seem to get on very nicely without the gall bladder or the spleen, two organs whose functions are still more or less of a mystery Nature draws a line however, at the liver This organ is the body's gasoline tank Here the muscle fuel — sugar — is stored prior to use and nature will not allow any tinkering with the fuel supply

Kidney function is of vital importance to bodily health The kidneys are responsible for removing waste products of a great food group, the proteins Interference with this function to any degrees is dangerous Its stoppage results in death the body simply clogs with its own refuse and the machinery stops But nature seemed to realize that infection or injury here might be very probable, for the kidneys, from the nature of their work as refuse removers can easily become infected So we have two kidneys, always in running order and always functioning, but we can get along very nicely with only one When necessary the surgeon can operate and remove an infected area of a kidney or a whole kidney, if necessary

Similarly, the bladder may become involved This condition is not as common as is kidney trouble, for the bladder is a very simple organ, in striking contrast to the very complicated structure of the kidney Nevertheless, disease may occur here and, when necessary, the doctor adopts heroic methods and removes the entire organ, with no serious danger to the patient's health but considerable inconvenience as to habits of cleanliness for his remaining life

Nature exercised the greatest foresight in the care of the brain, the control station for the human engine Not only did she enclose the brains in a case of armor—the skull—but she literally gave us two sets, just in case one got put out of action in the battle of life Generally

speaking, the human body is controlled from the left hemisphere of the brain In left-handed people this localization of control is reversed, but the general principles remain the same. So unimportant, indeed, is this unused side of the brain that it would be quite possible for a skilful surgeon to remove the entire right hemisphere in a right-handed individual without causing any serious effects. Death, in the case of head injury is because of blood pressing on certain structures at the brain base which control the action of heart and lungs The injury can be extensive but if no pressure is put on these parts the individual will not die Indeed, the odds are all in favor of his recovery, especially if he is young

One very curious fact about the brain is the very clear-cut localization of certain functions For instance, if you are a right-handed individual, you hear with the left side of your brain, just in from the temple. You see, curiously enough, in the extreme back of your head, left side This is where the nerve from your eyes ends You feel a burnt finger near the top of your head, just forward of the center line You talk with the extreme front of your brain, just over the eyes, and you play the piano, another motor activity, a little above your speech area, both left side If you are left-handed, reverse the sides and you have it If ambidextrous, heaven only knows what you do, but you probably favor the left side

A FRENCH-Canadian friend of mine was hit in the head by a shell fragment The left side of the skull above the ear was so fractured that a large silver plate was installed in its place The brain was, of course, badly injured The shock rendered him unconscious for a couple of weeks On recovery he presented a fine example of auditory aphasia, that is, loss of memory for all sounds He couldn't speak and he couldn't understand what you said, for the auditory memories were all wiped out But the right side of his brain was unhurt, so nature switched over to this "spare part" He learned very rapidly to speak, although he never did get back his native tongue, French A brilliant philosopher before his wound, his later views on Aristotle would have disgraced a college freshman, but he relearned his military manual in short order, returned to the front in a year's time, and ended as a colonel of infantry!

Nature will make interesting use of these spare parts in the brain when forced so to do For instance, we take a rat and teach him a visual discrimination test, such as to distinguish between a square and a triangle you feed him on the square but when he trespasses on the triangle he gets his paws shocked So he learns very quickly Like all mammals, humans included, he sees with the back of his brain, and there are stored his visual memories Now we operate on this section of his anatomy, removing the brain tissue next the visual nerve's end On recovery he has completely forgotten his trick, but he will learn it or a similar one again and just as quickly, using brain tissue farther removed from the nerve ending In other words, these large, so called "blind areas" of the brain are simply masses of reserve brain cells, of spare parts, waiting to function if and when necessary.

Some of the problems presented by these curious shifts in control are still very obscure For example, the so-called primary motor area is situated roughly above your ears When you have a "stroke" it is generally caused by a blood vessel bursting in this area and paralyzing the motor nerves which control arm, leg, or what not Such a mishap is very serious in those of advanced years Now, suppose we operate on a dog and carefully remove the motor area that supplies his hind legs On recovery he is of course, paralyzed Then a very curious thing happens At the end of a month, he begins to regain the use of his legs In two months he is as good as new And, to be quite frank, no one knows where the control has gone Nervous tissue never grows back, and in this case the neighboring tissue does not take over the management Our best research men have written reams on the subject, but that particular spare part is still missing It's like having an extra timer in your car, of whose presence you are certain but which is so cleverly concealed that the best mechanic in the country cannot locate it

The medical eye of the future will be even more concentrated on this problem of spare parts. Three groups of diseases are steadily increasing in frequency These are diseases of the heart or circulatory system, of the lungs or respiratory system, and finally our old enemy, cancer. The reason for this increase is obvious Your life expectancy has jumped from about 20 years to over 50 years in the past century We won't let you die of tuberculosis, typhoid fever or smallpox, but you've got to die of something sometime The machine just wears out, like any other engine and the two pumps, air and blood, generally go first. Perhaps some day we may literally have an artificial heart or lung

Cancer is the very worst example of a misplaced spare part It is simply ordinary body tissue gone wild Some cells in your skin, stomach, bone, or brain decide they are going to grow and do so, invading other organs and crowding everything out of place. Here are spare parts which could easily be spared with loss to no one. The dickens of it is that there is no germ to jump on—just ordinary body tissue and anything which kills this cancerous tissue will probably kill the other body parts at the same time. This is about as neat a stalemate as anyone could name; yet even here there is hope, for this cancerous tissue has certain peculiarities which may some day prove its undoing.

But we must have patience. Medicine with its allies in other sciences will continue to master the secrets of man, the machine. All it demands from the layman is an enlightened ignorance—in other words, co-operation, but not interference Here, as nowhere else, a little knowledge may be a very dangerous thing

INTERESTING, also, are certain "spare parts" which man has added of his own accord It seems fairly certain that he evolved in a sub-tropical or tropical climate. Here he could survive very nicely without a coat of fur, also, as a forest animal, he needn't worry about too much sun But ambition has always been his downfall First, he decided to leave his forest, then to go north That meant clothes, for his naked skin was poor protection against blizzard or the burning heat of the tropical veldt

These spare parts became just as necessary as many we have mentioned If you were a savage or even an early colonist in, say, northern New York State, and had your choice of living without your clothes or losing an eye, you would make the best of a bad bargain and part with the eye. Therefore, to early man came more demands for spare parts Furs and a fire can support life even in Canada, but if man is to have any peace of mind some form of house is absolutely necessary Hence this tropical animal endowed with intelligence moved his southern climate north in the form of an artificially heated home. When winter comes, he hibernates—with brief excursions into the outside world for farm chores, a dash to the office, or a ski trip. Yet, take away his clothes, rob him of his fire and the wolves could have all America north of Mexico, with some of the Mexican highlands thrown in!

The trend of evolution seems fairly clear. Man will add more of these external spare parts and lose some of those in his own body. Your glasses are becoming more and more essential Even the auto and the radio have almost become essential to human existence, not to mention many older inventions. On the other hand, man's teeth are going. They already are baby-like compared with those of the Java man, the Piltdown man or the Heidelberg man, his precursors of a mere few hundred thousand years back His little toe is also on the way out.

However, a good many of us suspect that man himself will fool Mother Nature and prevent further evolution—simply by himself becoming extinct within the next 100,000 years.

Science and Industry

A MONTHLY DIGEST

Conducted by F. D. McHUGH

Contributing Editor
ALEXANDER KLEMIN
In charge, Daniel Guggenheim School of Aeronautics, New York University

Neon Lamps Simplify Slip-Speed Checks

IN addition to the more involved and more expensive stroboscope equipment with which the test department of The Reliance Electric and Engineering Company is supplied for obtaining speed values of alternating-current machinery, its engineers have devised a simple, portable unit, using neon lamps, which is ingenious and as easy to use in the field as in the shop

Four, clear bulb, three-watt, neon glow lamps in a group, arranged as shown in the accompanying illustration, are used This is

A simple hand-held neon lamp unit accurately checks A.C. motor speed

necessary because the lamps are made for 115-volt circuits and to use them directly in the motor circuit, as must be done in testing, requires that provision be made for operation on 220 volts and on 440 volts

Four standard lamp bases are mounted on a small board A conical hood of steel, painted black inside, serves to keep out other light rays On the back of this board is mounted a switch for connecting the lamps for either 220 or 440 volts

The neon lamp can be used for obtaining the slip-speed of any alternating current motor with the exception of high-slip motors, operating at more than 100 revolutions per minute slip The device is easy to use by directing the light on the end of the shaft and counting the number of revolutions per minute of the keyway or other fixed parts on the rotating element. Marking the end of the shaft with a single chalk mark simplifies the counting, and using a stop watch increases the accuracy of observance of the time interval used Subtracting the slip revolutions per minute from the synchronous speed gives the motor speed

Of course, in a plant where all alternating current comes from the same source of controlled frequency, only a single neon lamp is needed

Weighting "Top-heavy" Destroyers

TOPHEAVINESS in 12 American destroyers, subject of much recent discussion, can be corrected by adding 40 or 50 tons of lead to the keel of each ship, rearranging stores, and removing some of the deck furnishings, Navy engineers state Total cost for work on the entire group of 12 destroyers is estimated at between $600,000 and $1,000,000

Weighting the keels may reduce speed by about half a knot This, however, is not regarded as serious, since the ships, designed for 37-knot speed, actually made 39 on trials

The destroyers of this group are among the most formidable armed craft of their class in the world On a designed displacement of 1570 tons, they carry 12 21-inch torpedo tubes, five 5 inch guns, and a number of lighter anti-aircraft pieces. The 5-inch guns in all recently built American destroyers can also be trained for high-angle fire against aircraft —*Science Service.*

Koroseal Paint for Corrosive Conditions

AGAIN extending the use of its recently introduced synthetic elastic, Koroseal, The B. F. Goodrich Company announces a new Koroseal paint, designated as No 495 Korolac A Korolac primer for use with the new paint is also available.

The new paint gives a semi-gloss black finish and is recommended wherever extremely corrosive conditions disqualify any other kind of paint or coating Applied to metal surfaces after they are prepared as for any other kind of paint or lacquer, the primer forms a strong bond between the Korolac and the metal itself

Korolac No 495, when thoroughly dry, will withstand all acids, alkalies, and salts in the concentrations commonly met with in industry, up to temperatures of 150 degrees, Fahrenheit It is not affected by chrome, nickel, cadmium, zinc, copper, brass, silver, or tin plating solutions, nor are such solutions contaminated or fouled by the paint when it is thoroughly dry.

Ordinary atmospheric conditions have no effect on the paint It is extremely moisture resistant The dried film is hard and resistant to abrasion, yet sufficiently elastic to conform to contraction and expansion of the support Both the primer and the paint can be applied by brushing or spraying

Tire Blowouts in Miniature

CREATING tire blowouts, in miniature, from highway hazards reproduced in the calm and quiet of the testing laboratory, is science's latest technique for combatting heat- rubber's worst enemy The new technique, helping to eliminate the blowouts from millions of tires for tomorrow's highways and to strengthen countless other future rubber products, is made possible by a novel testing device

Conceived by B F Goodrich Company technicians, the machine, which is shown on our cover this month, simulates the hundreds of gruelling impacts, the thousands of jarring vibrations which bombard tires during every minute of service life

The amount of heat built up by tires

Miniature tire blowout created by the machine shown on front cover

under various conditions is charted by the machine using tiny cylinders of rubber about as thick and half as long as your little finger, or equally small blocks of rubber and fabric, as test samples

These sample "tires," each cut out of finished tire tread compounds or carcass constructions, are pounded with 1800 impacts a minute until the inside rubber is changed by the intense heat to a liquid and gaseous mass which blows out

Already rubber compounders are converting technical data from tests on the machine, known as the Goodrich Flexometer, into sturdier and safer tires and other finished rubber goods

Longest Belt Conveyor

CONTRACT for manufacture of the longest belt-conveyor system ever installed (9 6 miles, from Redding to Coram California) for use in connection with construction of Shasta Dam, has been awarded The Goodyear Tire & Rubber Company and currently is in process of production in its Akron factories, for the Columbia Construction Company, Inc, of Redding The complete system will be twice as long as the largest ever built previously

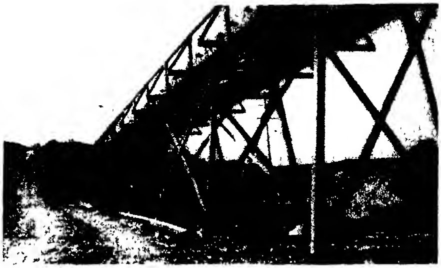
The Columbia job will require approximately 20 miles of 36-inch wide, six-ply, long staple cotton, rubber-covered belting, weighing approximately 1,500,000 pounds It will be installed in 26 endless, vulcanized-on-the job units for a continuous haul of sand and gravel up to six-inch cobble from the Columbia Company's gravel pits at Redding to the working area for the Shasta Dam at Coram Shasta Dam is being constructed as part of the federal flood control project for the Great Central Valley of California, to harness the waters of the Sacramento River

Roughly following the general contour of the rolling desert intervening between Redding and Coram, the belt conveyor will begin its haul at an elevation of 490 feet, carry through a pass at a maximum altitude of 1450 feet and make delivery to its extreme northern terminal at an elevation of 650 feet Installation is scheduled to be completed by March 1, 1940 and the system placed in operation by April 1, 1940.

The conveyor system will be erected on wooden bents varying in height above the ground from four to 90 feet and will require the use of 12,500 steel troughing idlers The 26 terminals, at which links of the system overlap, will be of combination steel and wood construction Dumping from one unit to another at the 25 transfer points will employ the use of steel chutes

The 26 links of the system each will be motivated with 200 horsepower electric motors, except the three most northern units which will generate power because they are down-grade, or lowering conveyors The component weight of the material on the slope makes these belts self operating

Capacity of the system will be 1100 tons per hour while conveying at a speed of 550 feet per minute Material in transit will be on the conveyor one hour and 40 minutes between extremities Four years of operation will be required to meet the total requirements of the dam construction project, estimated at 10 000,000 tons



Typical conveyor belt installation such as that described on this page

Labels Printed on Glass

BEAUTY is combined with utility in the new Anigraphic Process for printing labels on glass With this process, existing product labels may be duplicated with exact fidelity of detail and color combinations, or they may be applied without a background so that the contents of the container will show through the label Anigraphed labels may be washed and are resistant to ordinary solvents and abrasion

The new process is similar to lithography and is applied with a press directly to the surface of the container in one, two, three, or four colors in perfect register at one operation When the container is placed in an oven a moderate temperature fixes the ink, and the container is then ready to use

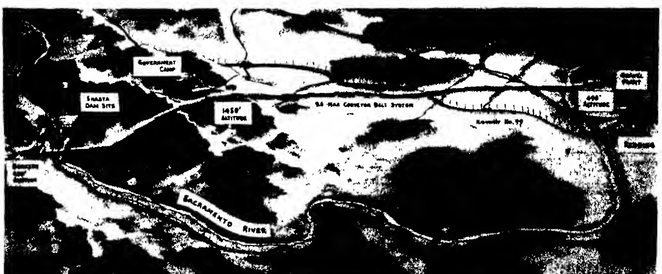
RAZOR BLADES

A SINGLE ton of high-carbon, cold-rolled strip steel will produce a million safety razor blades

New Division of Living World Proposed

THE old classical division of the world of living things into the plant and animal kingdoms should be revised, Dr Herbert F Copeland of Sacramento Junior College recently told a Botanical Society of America meeting

Proposals put forward by Dr Copeland included the setting up of two new "king



Artist's sketch of the long conveyor belt being installed at Shasta Dam, California

doms." One, including bacteria and certain other lower forms known as the blue-green algae, he would call the Monera, a term coined in the 19th Century by the German biologist Haeckel. The second, to include fungi and the red and brown algae, he would entitle the Protista.—*Science Service.*

Photographing Mesotrons At High Altitude

IT is interesting to note one of the services which superchargers are rendering in scientific research A Douglas DC 3 transport airplane, operated by United Airlines, equipped with supercharged Pratt & Whitney engines, recently and unwittingly broke the world's altitude record for the type of aircraft by flying to a height of 28,900 feet It carried two scientists of the University of Chicago, engaged in photographing mesotrons, the heavy radioactive components of cosmic rays The plane remained aloft for three hours and a half with the outside temperature at 30 degrees below zero, Fahrenheit. The two scientists used 800 pounds of equipment, photographic plates were exposed at the highest point of the flight As can be seen from our photograph, occupants were quite comfortable without overcoats, but had to wear oxygen masks.

The flight was part of the cosmic-ray investigations being carried on by Dr Arthur H Compton, Nobel prize winner, who maintained contact with the plane by radio.—*A K.*

Equipment for photographing cosmic rays at high altitudes

Operating the Turbo Supercharger

WRITING in the *Air Corps News Letter*, Captain Donald J. Keirn presents some interesting thoughts on the airplane supercharger and its operation. While the airplane supercharger is at least 20 years old, it has so far been installed on only a comparatively small number of Army planes, and only a minority of Air Corps officers are familiar with its operations Yet the supercharger today is extremely simple because an automatic regulator maintains sea level pressure in the air supplied to the carbureter up to the "critical" altitude of 25,000 feet The pilot merely sets the turbo regulator control to the desired pressure on a manifold gage, and then controls the engine by means of the throttle in quite conventional fashion.

Essentially, the turbo supercharger is a gas turbine coupled directly to a centrifugal air compressor The gases in the exhaust manifold of the engine are well above atmospheric pressure (even at sea level) and have a tremendously high temperature Thus they contain a tremendous amount of energy The exhaust gases expand to three or four times their original volume and down to the atmospheric pressure of the altitude at which the engine is operating. In so doing, they attain a tremendous velocity and this high velocity drives the turbine at 20,000 revolutions per minute The centrifugal compressor coupled to the turbine compresses the rarefied air of high altitude and the power of the engine is thereby maintained

Why is there the "critical" altitude mentioned above? Because the power of the exhaust gases remains practically constant The gage reading of the centrifugal compressor becomes very low at 25,000 feet With constant power and decreasing load, the turbo supercharger would revolve at a dangerously high speed and, to prevent this overspeeding, some of the exhaust gas must be by-passed, and less power given to the turbine Then the compressor receives less power, the incoming gas is not brought up to sea-level pressure, and so, beyond the critical point, the power of the engine, constant hitherto, begins to drop off fairly rapidly. — *A. K.*

Airline Feeder System

THE airmail pick up system recently described in Scientific American is one means of extending the benefits of air transport to small cities and towns. Airline feeder systems is another. Therefore, it is gratifying to learn that Airline Feeder System, Inc (with Richard T. Crane as president, and Bernt Balchen, noted pilot-explorer, as consultant) is applying to the Civil Aeronautics Authority for a Certificate of Convenience and Necessity permitting operation with airmail, passengers, and express to serve 34 cities in 15 eastern, northern, and southern states on a route of 2906 miles Many of these cities—Bridgeport, Elmira, Syracuse, Knoxville, and so on—have hitherto not enjoyed air service. The new airline is so laid as not to duplicate existing services and to feed into the main airlines Nothing will be more helpful to the extension of American air transport facilities —*A K*

Smoke Jumpers

WE recently described the experiments to be made by the Forest Service of the Department of Agriculture in dropping fire fighters by parachute These experiments, conducted in the Chelan National Forest, Washington, have proved entirely successful and the "smoke jumpers" will be of inestimable value in preserving our forests The latest account of these tests yields interesting information

The forest fighting 'chutes are 30 feet in diameter (much bigger than the ordinary 'chute) and descend at only 12 feet per second With this slow rate of descent, and flaps which permit the chute to be guided, a jumper can select his landing spot comfortably Even at altitudes of 8000 feet, where the thinner air gives less support, there is very little hazard in landing Parachute jumpers who had been fearful of the prospect of landing among tree branches were surprised to find that trees, located close together, acted somewhat as springs to cushion the landing and are preferable to hard, rough ground Rips and tears seldom occur in the silk canopy, and there were no instances of a canopy catching, then slipping, and finally dropping through the trees In other words, either the jumper comes straight through to the ground, or he is held securely suspended as shown in one of our photographs

The standard type parachute-harness

Photo by U S Forest Service

Parachute jumper wearing protective suit and helmet, and carrying 'chute and coil of landing rope

Photo by U S Forest Service

A "smoke jumper" preparing to disengage himself from his parachute harness and descend to the ground

proved a handicap in tree landing When a man hangs suspended from the crown of a tree, the pressure on the leg and chest straps of an ordinary harness is so great that he is unable to unsnap the connections and get free Therefore, the harness has been made so that it can be detached from the shroud lines When a man is caught in the trees, he detaches himself from the 'chute and reaches the ground by a rope which he carries—*A. K.*

Shoulder Safety Belts

RECORDS of accidents suffered by Air Corps pilots recently revealed a larger number of injuries to the head and face than to other parts of the body The reason is that the lap-type safety belt prevents the lower part of the body from being thrown forward, in case of a crash, the upper part of the trunk and the head are unrestrained and jack-knifed forward and the head strikes the instrument panel or other structural parts of the airplane To meet this situation, the Matériel Division of the Army Air Corps has developed a shoulder-type safety belt

In appearance, the shoulder safety belt resembles a pair of suspenders The front ends are latched to the standard lap type safety belt, the back ends are anchored to the airplane seat The shoulder belt can be loosened or tightened separately from the lap belt, but, when desired, lap and shoulder belts can be released simultaneously.

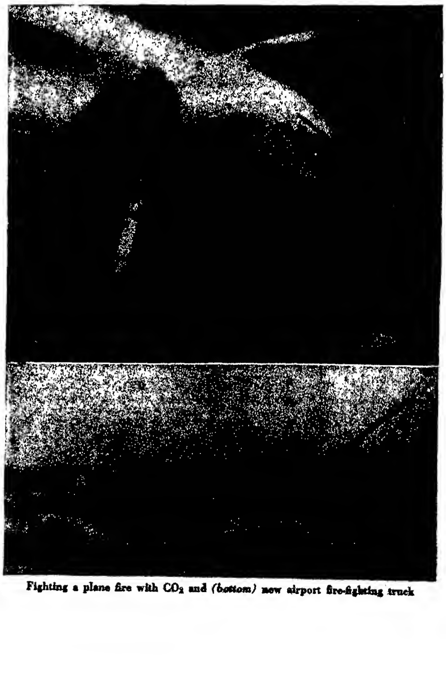
Laboratory tests have proved more than satisfactory The pilot's adjustable seat, with pilot in it, was suspended in a horizontal position from an overhead beam. Through a trip mechanism, the seat could be dropped a predetermined distance and abruptly stopped in its fall by means of a chain suspension An accelerometer measured the number of "g's" developed. Due to the hazardous character of the task, or because he weighs a convenient 200 pounds, it was Captain Harry G. Armstrong, Director of the Physiological Research Laboratory at Wright Field, who was the human guinea pig In a number of drops he felt the slight cutting action from the edges of the lap belt but experienced no pain or discomfort. On the basis of these tests, it is estimated that an enormous impact deceleration of 30 times gravity would cause no injury to the pilot If service tests are as favorable as experimental tests, the shoulder belt will become standard Air Corps equipment, with added safety for our pilots.—*A. K.*

Fire-Fighting at North Beach

THE magnificent North Beach Airport, La Guardia Field, has been splendidly described and illustrated in the daily press. There is one item of the equipment, however, which has passed relatively unnoticed —the fire fighting crash truck Safety measures at North Beach are so complete that crashes should be rare, yet they must be anticipated A huge and speedy truck, designed and built by Walter Kidde & Company, carries hundreds of pounds of carbon dioxide which is ejected through hoses in the form of gas to smother, within a few seconds, gasoline or oil flames following a crash. The principle of smothering fire with carbon dioxide gas has been well tried in electrical generating plants, cargo ships, and other industrial applications. Rushing out of high pressure cylinders, it dilutes the atmospheric oxygen and chokes off combustion The same gas is used in the fire-fighting equipment now carried on practically every airplane. In such installations, fire in the engine compartment automatically releases the heavy carbon dioxide.—*A K.*

A Curtiss Navy Scout

THE XSO3C-1, a two-seater scout and observation plane built for the Navy by Curtiss-Wright, has passed its tests in excellent fashion and has attracted favorable attention. It is equipped with the 12-cylinder Fairchild Ranger 'V" engine, which is inverted and air cooled But a short while ago, the radial air cooled engine seemed to have displaced every other type. Now the fine Ranger engine is being put into service in a number of ships One of our photographs reveals some of the reasons for revived interest in the in-line air-cooled type, the nose of the fuselage is beautifully streamlined, and, with the cylinders inverted, the pilot has a splendid view ahead.



Fighting a plane fire with CO_2 and *(bottom)* new airport fire-fighting truck

In spite of the moderate power of the Ranger (in the light of modern standards), the Curtiss machine has high performance and long range, for a seaplane of the observation variety. The central main float is braced to the streamlined fuselage by a single cantilever strut The tip floats, which provide lateral stability in the water, are also supported with a minimum of bracing. In addition to fine lines everywhere, a "mid-wing" is employed, that is a wing which is placed neither at the top of the fuselage nor at the bottom The "mid-wing" involves some difficulty in the "carry through" of the loads between the wings on each side, but also provides the best aerodynamic solution

While the experimental aircraft is a seaplane, the float system is interchangeable with a landing gear Such observation machines are now aboard Navy battleships and cruisers.—*A K*


High performance and long range are features of the XSO3C-1 Navy scout

Stainless Steel Coins

PROPER acknowledgement and thanks should be due from the Italian Government to one of our readers, Mr John H Pearce of Seattle, Washington Mr Pearce suggested back in 1932—and we published his suggestion in full—that stainless steel coins should prove far more satisfactory, for a great number of reasons, than coins of other metals usually used Among other advantages of the stainless metal, our article said that it would be as cheap as, or cheaper than, the copper that now goes into our cent, that it would not corrode no matter how long it is hoarded in the child's bank or handled with perspiring hands, that it would wear longer because it is harder, and that it would leave no disagreeable odor on the hands.

So far as our records show, Mr Pearce's suggestion was the first such ever made, and now the Italian Government's use of

stainless steel to make coins is the first such use. Several new Italian coins made of the metal include the following pieces: 20 and 50 centissimos, and the 1 and 2 lire pieces. The special type of stainless steel used contains 22 percent chromium, 12 percent nickel, and a small amount of molybdenum.

Pruning Tools Spread Sycamore Disease

THE disease of the London plane tree and native sycamore, now a killing epidemic in Philadelphia and Baltimore, can be introduced into even very small wounds in healthy trees, by pruning tools, according to tests by Dr. J. M. Walter of the Division of Forest Pathology, Bureau of Plant Industry. The London plane, commonly called a sycamore in this country, differs from most trees in that it grows well in cities. The plane-tree disease was first noticed in Philadelphia, and has been found in New Jersey, Washington, Virginia, North Carolina, West Virginia, and Mississippi.

Doctor Walter urges special care—by tree surgeons and others pruning and caring for trees—in the careful disinfection of tools before they are used again on healthy trees Wash the tools in alcohol, he says. While the disease occurs in the large cities chiefly on the London plane tree, it has been found elsewhere in smaller towns on the American sycamore.

Small samples of living or recently killed wood taken from suspected trees and showing brownish, reddish, or bluish black discoloration may be sent to the Laboratory of Forest Pathology, Morristown, New Jersey, for determination of the disease.

AIR CONDITIONING

MORE than 2000 industrial air conditioning installations are not only improving the health and efficiency of employees but are also increasing production, reducing loss by rejections, and eliminating dirt and abnormal moisture in many manufactured products.

Aluminum Film Prevents Silicosis

IDENTIFICATION of a film which, by covering quartz particles, prevents silicosis, was recently reported by L. H. Germer and K. H. Storks of the Bell Telephone Laboratories in *Industrial and Engineering Chemistry*.

The protective film is hydrated oxide of aluminum, and is so thin that no way exists of making it visible. Its identity was discovered by electron diffraction analysis, in which a beam of electrons was passed through the film specimen and the resulting diffraction pattern recorded on a photographic plate. Features of the pattern were then examined to identify the material composing the film.

Silicosis develops rather quickly in rabbits exposed to air containing moderate concentrations of quartz particles finer than one two thousandth of a centimeter, but it is completely prevented if aluminum powder is also present in the air to the extent of about 1 percent by weight of the quartz powder The aluminum forms, in the lungs, a protective film upon the surface of silica particles which prevents them from dissolving, and thus prevents toxic effects.

"The seriousness of silicosis in the mining and foundry industries indicates the importance of identification of this film," it is declared "The smallness of the silica particles and the very small amount of aluminum which is sufficient to cover them with a protective film make it evident that this film is extremely thin It is estimated that a film 250 Angstrom units, or one forty-thousandth of a millimeter, thick will certainly prevent solution of silica and toxic effects The minimum thickness of film which will prevent solution is probably very many times less than this figure."

Snow Photos From Air

BOMBS of carbon-black powder, dropped on the snow from the map-making planes of the third Antarctic Expedition, will permit faster and more accurate overlapping of aerial photographs necessary in claiming rights to Antarctic areas by the United States. A large quantity of uncompressed carbon-black powder to be used for that purpose has been donated to the Expedition by the Continental Carbon Company.

Both the plane carried atop the roof of the huge Snow Cruiser and the planes based at "Little America" will carry the black-powder bombs on their aerial survey flights. Every few miles, just prior to taking a photograph, the planes will release a powder bomb which makes a big black splotch

on the snow. When the photographs of the barren wastes are developed, the black spots on the pictures will provide an accurate and quick method of piecing them together to form the aerial map.

Spotting of the ice and snow fields in this manner is necessary because there are practically no landmarks to identify a particular area—nothing but endless wastes of perpetual whiteness.

Street Lighting Evaluator

DEVELOPMENT of an ingenious instrument which, for the first time, enables safety authorities quickly, conveniently, and accurately to evaluate the effectiveness of street lighting systems has just been announced by General Electric's lamp department at Nela Park.

Its significance derives from its relation to the 5000 lives that are annually lost in traffic accidents merely because motorists could not see safely Experts to whom the new instrument has been shown hail it as an effective tool for diagnosing street lighting systems and prescribing the means of affording adequate visibility

The new street lighting evaluator serves as a traveling laboratory It "sees" and promptly records the true brightness of pavement, brightness of objects on and near the roadway, and the interference with seeing caused by the glare from the lighting system These are the three factors that determine how quickly and clearly and certainly a driver can see It permits the safety official to determine visibility values without having to step out of his car

One of the evaluator's several parts, mounted on the hood of an automobile and extending beyond the radiator, resembles a stubby spring board A second part, above the windshield, looks like the loud speaker of a public address system A third element, on the driver's seat, resembles a portable radio.

What appears to be a spring board actually is a miniature strip of street The pavement is similar in tone and texture to the surface of the roadway in question On it are typical obstacles Its position above the headlamps of approaching cars makes it possible for the investigator to proceed with an appraisal at any time without waiting until traffic has disappeared.

What first might be taken to be a loud speaker above the windshield is really a glare collector which measures the total glare from all street lamps, within the driver's field of view, and the loss of vision resulting therefrom.

What looks like a portable radio on the driver's seat is an "operator's control box" provided with dials and selector switches It automatically records on a card the measurements of the three factors (brightness of pavement, objects, and interference with seeing caused by glare from the system) Only a few moments are required for the operator to compute the net visibility at a given location.

Rapid Lettering Set

A FAST, accurate, versatile and economical lettering set has been announced by the Eugene Dietzgen Company. An outstanding feature of the Edco "Spee-Dee" lettering set is that with a single guide, it is possible to produce eight differ-

Neat, accurate lettering may be produced with this new device

ent types of lettering simply by changing the setting of the tracer and the pen arm.

Each lettering outfit has six different weights of pen points from extra light to extra bold, thus making 48 different weights and styles of type available Letters are formed in one continuous movement without shifting the guide, because each character on the guide is complete and in alphabetical order Each guide has upper and lower case letters, numerals, and characters Proper positioning and spacing of letters are made easy by the spacing markers The guide is precision-built of special, durable plastic material.

Naval Construction

OUR naval building program, off to so late a start in the opinion of many of us, now seems to be making such rapid strides that in the next few years we will approach reasonably close to an adequate Navy. Latest figures on construction of naval vessels in this country are appropriate just now when attention is centered upon the extent of our defense forces.

On October 1, 1939 four of our new battleships were already under construction and contracts awarded for four more. Probably the *North Carolina* will be the first to be launched some time this spring Two aircraft carriers are under construction, one of them having been launched last April. Six light cruisers have been authorized but contracts have been let for only four of them, and construction has begun on none. Three submarines have been launched of the nine under construction, and eight more have been authorized but not begun. Nine destroyers have been launched among the 28 now under construction, while seven more have been authorized but not begun We are also building tenders, minesweepers, a repair ship, fleet tugs, mine layers, and sub chasers, totalling 19 vessels, about half of which are under construction or have been launched and one has not been contracted for

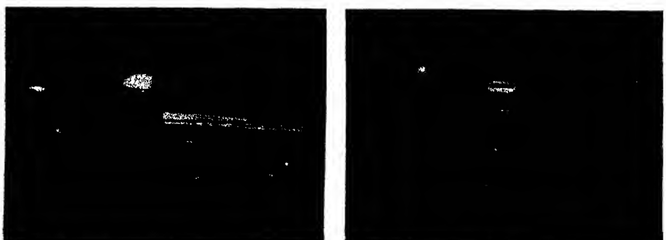
FORESTS

FOR a number of years prior to the war, Germany was overcutting her forests by 50 percent. That country produces normally only about two thirds of its annual wood requirements, and the present war is, therefore, expected to cut so deeply into German forests that it will take years to replenish them

Motor Noise Finder

AN "industrial stethoscope" for use by acoustic engineers engaged in the diagnosis and checking of running machinery has been announced by Electrical Research Products Inc Just as a doctor listens to the heart beats of his patient and then charts his condition, so the Recording Frequency Analyzer (as the new device is called) discloses the "sound" condition of motors undergoing test, and records the results on a graph automatically

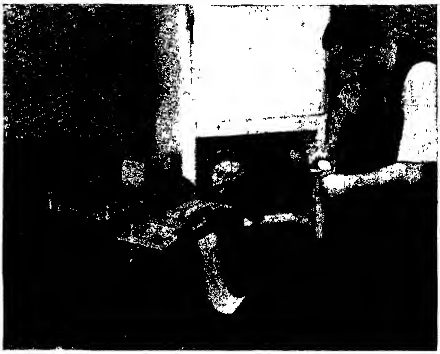
The equipment employs frequency analysis by the "sweep" method, using a small drive-motor to actuate the frequency dial which sweeps the whole range of frequencies from 30 to 10,000 cycles per second. With this motor is synchronized another



Two views of street lighting evaluator equipment, showing glare collector and miniature street

motor driving a band of graph paper on which a stylus traces the sound level at each frequency passed. Sharpness of frequency selection from the great variety of sound that the microphone picks up from a whirring machine is assured by crystal filters.

Thus the acoustic engineer has a completely plotted and permanent chart of the sound levels at various frequencies. Having tested both good and defective machines in this manner, the engineer knows the eccentric sound peaks at certain frequencies which are symptoms of the defects most chronic to the type of machine tested. He may then recommend that the manufacturer install one of the recently announced Industrial Noise Analyzers (or electrical "tin ears") which, set to the particular frequency which betrays the defect, becomes a watch-dog against its recurrence.



Testing refrigerator unit with recently announced "industrial stethoscope"

One Millionth of an Inch

ACCURACY to one millionth of an inch is the answer of roller bearings to the ravages of friction. And it's done with mirrors.

Using a machine so delicate that it must be kept in an air-conditioned room, The Timken Roller Bearing Company has achieved a new super-finishing process on the metal raceways in which rollers revolve that eliminates irregularities not even visible with a microscope.

Above Equipment for measuring surface roughness to one millionth of an inch. *Below*. Path of light ray that makes measurements possible

Reduced to its fundamentals, this instrument consists of a light beam reflected between a series of mirrors, the first of which is hinged and changes its vertical angle as the specimen is drawn along under it. This is accomplished by mounting this mirror on a bell crank lever pivoted in the center, with a diamond point on one arm and the mirror on the other.

As this diamond point makes contact with the specimen surface, any minute irregularity moves the mirror system. This movement is transferred by the mirror deflecting the beam of light. The deflection of the beam is accentuated in reflecting off each mirror. Finally the beam runs through a condenser which reduces it to pin point size and focuses it on a revolving cylinder of sensitized photographic paper.

When the paper is developed, irregularities of a millionth of an inch show up like saw teeth. The machine is so sensitive that if the specimen is .000025 of an inch off level, it will show up as an error of 1/8 inch on the sensitized paper.

The direct result of profilograph studies has been a new type of surface finishing. Hence, honing machines were developed. This consists of fine abrasives being held lightly against a piece of work, with the abrasive and the work moving in several opposing directions. Honing has unquestionably lengthened the already long serviceable life of precision bearings by practically eliminating internal friction.

TRAIN SPEEDS

THAT the United States has made amazing progress in the speeding up of passenger trains in recent years can be seen from the fact that, in 1932, American mile-a-minute daily runs totalled only 2022 miles, while today, they have reached 48,247 miles. American railroads also operate 4415 miles at 70 miles or more per hour, and 1012 miles at 75 miles or more per hour.

Infra-Red Spectroscopy in Industrial Research

IN recent years a new method of analysis of organic compounds has been put into practical application. It has been found possible to use infra-red, or heat, radiation to "finger print" complex organic molecules for identification and analysis. This method applies only to molecules and is not to be confused with the well established spectrum analysis of the elements which utilizes the visible and ultra-violet light given off by atoms.

The infra-red radiation, sometimes called

"black light," used for this purpose is invisible and must be picked up by a very sensitive heat detector, the thermopile, which can "feel" and measure a rise in temperature of only a hundred millionth of a degree

An instrument known as an infra-red spectrometer does the actual "finger printing" of the molecules. This instrument, the heart of which is a one-pound prism of rock salt, automatically separates the radiation into its various wavelengths and records their intensities. A sample of the organic compound under investigation is placed in the path of a beam of infra-red radiation, and the radiation which passes through is measured and recorded by the spectrometer.

It has been found that after passing through any given organic compound, the infra-red radiation will have lost a certain set of its wavelengths, resulting in what is called an absorption pattern. The key to the whole matter is that no two different organic compounds have ever been found to have identical absorption patterns.

This fact makes possible the rapid identification of an unknown compound simply by comparing its absorption pattern with the patterns of known compounds. The task is ended when a perfect match is found A more important use of the method is the identification of compounds which are present as impurities in other compounds. This type of chemical problem has been dealt with very successfully by the new method in a large number of cases.

Perhaps even more important is the fact that accurate quantitative determination of the amount of impurity in a compound can be made with the infra-red spectrometer. Amounts of impurity in organic compounds as small as 0 01 percent have been detected and measured. Furthermore, a not inconsiderable item to the chemist is that only a few drops of the sample are needed for the analysis and even these few drops can be returned unharmed afterward.

OILDEX AND FILTREX

EXCLUSIVE manufacturing and sales rights for the production and distribution of an oil dilution extractor and an improved type oil filter, companion motor products designed to effect oil and gasoline savings and reduce motor maintenance cost, have been acquired by Bridgeport Brass Company Both products are patented and will be sold under the copyrighted names of "Oildex" and "Filtrex"

Claiming that the oil dilution extractor is the only device of its kind on the market today, where dilution extraction and filtration are accomplished, the company declares that the use of this product in combination with the oil filter, in addition to providing substantial oil savings, has shown consistent gasoline savings of from 5 to 20 percent, depending on the condition of the motor when the installation is made, and reduction in motor maintenance cost by as much as 50 percent.

Both the oil dilution extractor and the oil filter are for installation on the automobile and can easily be installed by a competent mechanic in a short time. The Oildex, for example, has an inlet and outlet tube; the inlet line is connected to the crankcase at some point above the oil level. If the car is

Oil dilution extractor for use on automobiles, with connecting lines

equipped with a breather pipe, the inlet tube is connected by means of an adapter and the line is run from the adapter to the oil dilution extractor where the volatile gases are filtered and are sucked by vacuum into the intake manifold connected to the extractor by another tube. The oil filter is installed in accord with accepted practice.

AUTO TAXES

AFTER an automobile is built, tax collectors, during its lifetime, collect $4 for every $1 that was paid to workmen for building the car.

Pigment Research Improves Paints

FORMULAS for exterior white and light-tinted paints with improved durability, better hiding power, and greater freedom from dirt collection, have been developed for various climates as the result of an extensive research program conducted by the Krebs Pigment & Color Corporation.

Recent developments in house paint technology have dealt primarily with the production of improved titanium pigments and the methods of incorporating them most advantageously into exterior paints. Titanium dioxide is a comparatively new paint pigment which was at first confined to use in white paints.

According to the findings of this research program, white and light-tinted house paints containing titanium pigments properly combined with other pigments, have exhibited properties far superior to those of any of the older type paints.

As titanium dioxide is several times as opaque as any other paint pigment, paints incorporating it have better hiding power, and are of a clearer, more brilliant white. Because paints containing titanium dioxide tend to fail by chalking rather than by cracking or checking, they are inherently "self-cleaning," and make an easier and more satisfactory surface for repainting. With formulas varied according to climate, they are also slower to show paint failure.

A recent achievement is a specially pro-

cessed titanium dioxide, developed by Krebs, which makes practical the use of this pigment in a full line of light-tinted house paints. This new pigment overcomes the tendency of tinted shades to fade when made with pure titanium dioxide, and is more chalk resistant. In addition, paints made with it have exceptional durability and hiding power.

SEALED HEADLAMPS FOR OLDER CARS

DEVELOPMENT of two new all-glass sealed headlamps, designed expressly for use on front bumpers of cars made prior to those equipped regularly with sealed lights—some twenty million in all—was announced recently by General Electric's lamp department, Nela Park The new lamps will be made available early in February One of each is to be installed on a car bumper as shown in one of our illustrations

The new sealed lamps are designed to supplement present headlighting of older cars Proper use of the new all-glass units, according to automotive lighting engineers, will give motorists headlighting approximating that provided by 1940 cars which are equipped with the popular "Sealed Beam" headlamp systems

Like the all glass Sealed Beam lamps on many of the latest models, each of the two new sealed lamps consists of a high efficiency light source, a hard glass reflector mirrored on its inner surface, and a special lens—all parts hermetically sealed into a single unit

One of the new lamps, called the "sealed driving lamp," produces a symmetrical beam of about 35,000 candlepower and, like the "country beam" from Sealed Beam lamps, has a moderate amount of light above the horizontal This beam is intended to supplement the light from upper beams of cars of 1939 and older.

The other new sealed unit, called the "sealed passing lamp," is equipped with a lens especially designed to supplement light from the lower or "meeting beam" from old-style headlamps It provides a wealth of illumination along the right side of the roadway without creating glare for approaching drivers. The beam, rated at 35,000 candlepower, is similar to the "traffic beam" from Sealed Beam headlamps Its light distribution is said to be "asymmetrical," the

Side view of new sealed headlamp for older cars, showing also the connection block on rear of lamp

How sealed headlamps are mounted on the front bumper of older cars

illumination being spread to the right only

Nela Park engineers recommend that the sealed driving lamp be wired in such manner as to come on with the upper beam of the regular headlamps The passing lamp should be wired to come on with the lower beam of the regular headlamps Each lamp should be wired through a switch clamped to the dash to permit the driver to turn them off when the car is being driven on lighted city streets

FLOWERS

LARGE quantities of roses and other cut flowers are shipped from Pacific Coast to Atlantic Coast cities in refrigerator cars attached to fast passenger trains

No Petroleum Shortage

EVER since that eventful day in 1859 when Colonel Edwin L Drake and "Uncle Billy" Smith discovered that petroleum could be brought from the earth by drilling, persons throughout the nation have expressed the belief that petroleum resources soon would be exhausted Even during years when the industry had a surplus rather than a deficiency of oil, revivals of these alarms were heard Today, despite the fact that proved oil reserves are conceded to be well over 100 percent greater than estimates of a decade and a half ago, alarmists not only insist that they soon will be exhausted but in some instances have charged the industry with unnecessary waste and an unwillingness to co-operate in conservation

As a result of the frequent charges of waste, the American Petroleum Institute, in 1925, made a thorough study of the industry and conservatively reported the known future oil reserves as 5,321,000,000 barrels During the next 10 years 8,692,000,000 barrels were produced, yet authorities agree that today we have future proved reserves of some 17,000,000,000 barrels—more than three and one half times the estimates of the mid-twenties!

But that is not all! During the past few years science, technology, and the inventive mind of man have so widened our horizon that those most familiar with the subject believe that reserves still to be located and developed are much greater than ever estimated.

The last 10 years rightfully may be termed "a decade of advancement." Engineering advancements have resulted in improved production methods by which increased recovery is possible. In addition, better engineering practices and geological advancements have permitted more accurate determinations of the location and the quan-

tity of oil in the earth and the industry is vitally concerned in securing the greatest recovery from every pool.

While means of increasing the recovery of oil fields were being developed, better refining methods for increasing recoveries of the most valuable oil fractions were found. Thus, today it is possible to give assurance that known reserves, plus the development of those certain to be located at a future date, plus substitutes, should they ever be required, are ample to meet every demand.

Any discussion of the future adequacy of petroleum products should begin with the probable future demand. This is dependent on the nation's probable gain in population, the increase in the number of motor cars, and the requirements for petroleum products by industry and in the home.

To make a fair analysis of what is to come during the next several decades, one first must consider the probable increase in population from 122,000,000 to an estimated 146,000,000. During this same span, the number of passenger vehicles is expected to increase from 25,000,000 to some 31,000,000 and the number of motor trucks and buses will step from 4,300,000 to some 6,000,000. In other words, the anticipated number of motor vehicles in 1960 will be 37,100,000 as compared to 29,500,000 today.

From this, one might hastily conclude that the consumption of petroleum products for use in motor vehicles will skyrocket within the next few years. Such, however, will not be the case. According to reliable authorities, the annual motor fuel consumption per vehicle operated in the United States has decreased from an all time high of 721 gallons in 1937 to 704 gallons in 1938. This reduction in gasoline consumption is a result of the trend to lighter vehicles powered by more efficient engines, and automotive engineers predict that future advancements will reduce the per-vehicle consumption of gasoline to the neighborhood of 670 gallons in 1960.

In addition to motor fuel, the barrel of crude of 20 years hence will continue to be drawn upon for domestic demands of kerosene, lubricants, marine and Diesel fuels, heating oils, and other uses. Weighing the probable crude supplies from domestic sources against expected demands, it is estimated that the peak will be reached in about 10 years when 1,109,800,000 barrels will be required. By 1960, it is believed that this demand will drop to in the neighborhood of 1,071,000,000 barrels—a figure which closely approximates that of today's crude-oil production.

In any fair discussion of the subject, one must bear in mind that refinery improvements already in operation and those which will come as a result of unending research in refinery technology and operation will increase the yield of gasoline obtainable from a barrel of crude. Conservative estimates for 1960 indicate that nearly 60 percent of the crude will be converted into motor fuel as compared with slightly over 40 percent, the recent average for the industry.

Because of the discoveries which have been made and which will continue to be made in the finding, production, and refining of crude, it is quite evident that a shortage of petroleum is remote. Known reserves of today are well over 100 percent greater than estimates of 1925. Properly managed,

as in most instances they are today, these reserves, together with new discoveries, are sufficient to relieve any doubt that a shortage of petroleum is imminent—*The Orange Disc* Magazine.

Aluminum Roofs

A STUDY of the performance of aluminum finishes as applied to metals and other surfaces has convinced engineers that this metal would so resist intense sunlight and oxidation that it should make a highly suitable roofing material Hence the Paraffine Companies, Inc., have developed a new roofing called Alumi Shield which takes advantage of the well-known characteristics of aluminum It has high reflective properties and provides good insulation at a much lower cost than do other comparable metals. This new roofing consists of prepared asphalt roll roofing surfaced with metallic aluminum.

Portable Pack Water Filter

A GROUP of men—campers, hunters, explorers, engineers—far from a municipal water supply, can now purify their own drinking water, wherever they

Above: Operating pump of portable water filter. *Below:* The entire unit may be carried on the back

may be located, with the new Seitz Portable Pack Filter. Packed for transportation on the back of a man, the equipment weighs between 30 and 40 pounds. The unit is completely self-contained with a hand pump that will supply up to five or six gallons of potable water per minute. Easy pumping will supply one or two gallons per minute

All parts of the filter are built of aluminum coated with a special water-repelling Bakelite lacquer to prevent oxidation The hand pump which supplies the water is positive acting, that is, needs no priming It provides a suction lift of at least 10 to 15 feet

Moles, Birthmarks and Cancer

THE common mole, skin-colored or a little darker, "rarely, if ever, terminates in cancer," and blood-vessel birthmarks and the dark brown, warty, hairy birthmarks are also relatively innocent of cancerous tendencies, Dr Eugene F. Traub, of New York City, declared at the recent meeting of the American Academy of Dermatology and Syphilology.

"The smooth, dark brown or dark blue marks, devoid of hair, are the ones that are most dangerous. It is from this type that melanoma (serious skin cancer) often develops," he said

Skin cancers, Dr Traub emphasized, are easy for the doctor to diagnose and generally can be cured by X-ray or radium treatment or surgical operation —*Science Service.*

Dwarf Apple Trees

A DWARF apple tree that will not grow taller than a man can reach and which will bear fruit the first or second year after it is planted is now a practical accomplishment and should meet an increasing demand among amateur gardeners and home owners, says Dr H B Tukey, horticulturist at the State Experiment Station at Geneva, New York, who cites the many inquiries received at the Station as an indication of the mounting interest in trees of this type as ornamentals and novelties for the home garden.

"Fortunately," says Dr Tukey, "tests made at the Experiment Station have now progressed to the point where we can give direct answers to such questions as 'How soon will dwarf trees come into bearing?,' 'How big will they get?,' 'What kind of fruit will they bear?,' 'What varieties shall I use?,' 'What special care must I give them?'

"The trees which are now becoming available are true dwarfs and are produced by budding the desired variety on a rootstock known to nurserymen as 'Malling IX'. These trees are especially well suited for training to special shapes, many varieties will bear the first year and the rest the second year, and while they should not be

regarded as trees to produce the family supply of apples, they make exceedingly attractive ornamentals and often the bloom alone is sufficient to repay the planter for his time and labor."

Dwarf trees should be regarded as garden plants and will require much the same careful handling as do other garden plants, says Dr Tukey, who concludes that, "for the amateur gardener and small home owner, however, they are exceptional, useful, and interesting novelties."

Photographic Drawing

MANY years ago a considerable proportion of the illustrations used in newspapers were made by drawing over photographs and then removing the photograph from beneath the drawn lines by means of chemicals. Thus, while the process is not new, it has now been made available for

From photo to drawing

extremely easy operation by the layman in a small kit recently produced by Chas M Higgins & Co, Inc This inexpensive kit contains the necessary chemicals, a bottle of brown India ink and one of black India ink, mixing bottles, brush, a pen, and even a sample photograph on which to experiment

This kit is not, however, wholly a hobbyist's outfit It can be made use of by editors who wish to make from a photograph a line cut instead of a more expensive half tone An architect, in preparing for alterations in a house, may draw part of the house on an old photograph and then sketch in the desired changes Other uses may suggest themselves to readers

Stainproof Paint

INTERIOR house painters are plagued with the problem of old stains showing through new coats of paint Only too often it is necessary to put several coats of paint over such stains, with the possibility that the stain will later make its way through these coats and show up again Staincure is a new paint made to solve this problem It is a ready mixed, white, flat, sealing paint with extremely high hiding power It is, furthermore, quick drying

The manufacturers claim that Staincure is an excellent primer for use as a one-coat finish on such products as fabricated doors, windows and sash, and the like. In such use it prevents pitch and sap stains from bleeding through.

Four-Lane Road "Jacked" Apart

HOW a four-lane highway that was "jacked" apart to make a divided roadway reduced fatal accidents by more

than 83 percent, was described recently by Arnold H. Vey, traffic engineer of the State of New Jersey.

New Jersey took a popular four-lane highway and split it down the middle, moving separate concrete slabs sideways Two roadways, separated by a dividing center strip, thus resulted

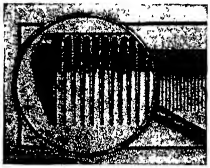
A study of accident figures on this road in 1933 34, before the division, and for 1937-38, after the division, showed that fatal accidents dropped 83 3 percent Non-fatal accidents decreased 48 5 percent and accidents involving property damage were cut 17 6 percent The reduction for accidents of all kinds was 40 4 percent

Particularly valuable was the new divided highway at night, for accidents were then decreased by 47.2 percent while during the day they dropped only 31 4 percent

The cost for the unique jacking job was $50,000 per mile, Mr Vey reported. By applying National Safety Council figures to the reduction in accidents, it was found that the saving in accident costs are sufficient to pay for the conversion in slightly over three years —*Science Service.*

Self Cleaning Comb

WHAT is said to be the first basic improvement in combs in 4000 years, a new one, called Komatic, has been placed on the market In this comb the backbone



has been pushed completely to one side so that the teeth slots go all the way to the back edge Its self-cleaning characteristic is said to be due to the fact that this side backbone gives a sharp edge on one side and there are no pockets in which hairs or lint may collect.

Problem: The Chord and Arc

HERE is another of Lieutenant-Commander Kaplan's headaches for those —and there are a lot of them—who really enjoy headaches and claim the problems don't make heads ache hard enough.

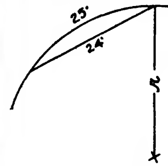
Find the radius r of the circle in which a 24′ chord subtends a 25′ arc.

For those who find the problem too elementary, the additional one is offered to deduce a series which defines the radius r *explicitly* in terms of the chord c and the arc a—a series, that is, which will permit numerical computation of r by direct substitution of the known values of c and a.

In transmitting the above problem, Commander Kaplan underlined the word "explicitly" in red ink, and then stated in his letter that the emphasis was put on the word in order to forestall a deluge of series which define the unknown radius implicitly.

Well, that ought to be explicit enough, speaking explicitly!

Address any correspondence regarding

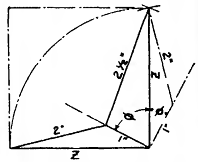


this problem to Lieutenant-Commander Leonard Kaplan, in care of Scientific American, 24 West 40 St., New York, N. Y., to whom it will be forwarded unopened.

Solution to the Problem of the Square

LAST month we suggested that you try to construct by graphical means a square having three corners at distances of 1, 2, and 2½ inches from a point within the square, also compute the length of a side of the square. Here we have our solution.

Referring to the illustration it will be easy to follow the construction. First lay off



one inch lengths, measured from the vertex, along the sides of a right angle. From these points as centers, swing arcs with 2 and 2½ inch radii. The line connecting the intersection of these arcs and the vertex of the right angle is one side of the square.

To determine the length of a side, we have the following expressions derived from the cosine law

$$25/4 = Z^2 + 1 - 2Z\cos\theta$$
$$4 \quad = Z^2 + 1 - 2Z\cos\Phi$$

where Z is the unknown side of the square, and θ and Φ are respectively the angles opposite the 2½ and 2-inch sides in the triangles shown in the graphical construction. The equations may be rewritten as

$$4Z^2 - 21 = 8Z\cos\theta$$
$$4Z^2 - 12 = 8Z\sin\theta$$

Squaring each side and adding gives

$$32\,Z^4 - 328\,Z^2 + 585 = 0$$

Solving as a quadratic in Z^2, we have

$$Z^2 = \frac{328 \pm \sqrt{(328)^2 - (4)\,(32)\,(585)}}{64}$$

$$= \tfrac{1}{8}\left(41 \pm \sqrt{511}\right)$$

and so Z = 2.8197 or 1.5164 inches. The first of these two values is the correct answer, the latter being the length of a side of a square with the three corners at the given distances from a point *outside* the square.

YOUR FIREARMS

Conducted by A. D. RATHBONE, IV

INTEREST IN FIREARMS *is traditional with American men, science has so developed them that millions yearly find sport and recreation in their use Hence this monthly department presenting a wide variety of discussion regarding firearms, their handling, and their accessories Suggestions from readers will be heartily welcomed*—The Editor.

Old Sights—New Sights

HAD the flintlock muskets of our Colonial troops, entrenched on Bunker Hill in June, 1775, been equipped with modern sights, that famous command "Don't shoot until you can see the whites of their eyes" might have had an even more devastating and a considerably earlier effect on the Redcoats storming the American ramparts Actually, sights, so called, were in evidence on firearms as early as 1475, but it remained for Maurice, of Orange, to make his mark in history in 1598 by designating muskets with sights for the army of the Netherlands

Although development of "iron" sights for hunting rifles has advanced apace during the past 60 years to the point where scientific details and data are legion, the great great-grandfathers of many of our present day sights are to be found on ancient weapons of European make Why the early arms were so equipped is something of a puzzle, for, after all, about the best a would-be marksman could do with one of those early guns was to point and hope. Without rifling, which was the case with many early guns, a true aim as we know it today was almost a miracle

In examining some of the antique firearms in the possession of The International Studio Art Corporation, formerly a part of the William Randolph Hearst collection, the other day, we came across the early antecedents of the "buckhorn" sight, the peep sight, the folding leaf sight, the telescope sight, and finally, the interchangeable disks with varying sizes of apertures, which the Merit Gunsight Company has recently modernized even further through the manufacture of an iris type disk which offers 12 different apertures by means of a click adjustment

The fore runner of the buckhorn sight was found on a matchlock arquebus of 1583, originally made for Francis II, Duke of Saxe Lauenberg Incidentally, this weapon is considered one of the finest antiques of this type and is valued at about $5000 The ancestor of the folding leaf rear sight came to light on a Hungarian wheel-lock arquebus made by Johann Stiffter in 1682 Stiffter is recognized as one of the finest of early gunsmiths, and this sight consists of three leaves, offering various stages of elevation.

On a matchlock arquebus of probable Dutch origin in the late 17th Century, we discovered the several times great-grandpappy of the 'scope It has no magnification, of course, and is merely an octagonal metal tube 1¾ inches long with a 3/8 inch diameter at the butt end, tapered to a 5/32 inch opening at the fore end Nevertheless, here is an early adaptation of the 'scope principle, wherein the shooter sighted through a small cylindrical tube for the purpose of bettering his aim

The peep sight we examined was startling, to say the least It took the form of a four-legged metal lizard, lying on the top of the barrel, with open mouth gaping directly into the shooter's eye However, the lizard

Left Folding leaf sight of 1682. *Right*. Ancestor of buckhorn sight.

has a hole through the top of its head, and when one peers through this physical defect, he sights along the gun over a crude head fore sight and hopes his aim will be bettered This combination matchlock and wheel lock gun was of Oriental origin, 1650.

One requirement of the modern rear peep sight for target use is an arrangement for an eye cup, or a series of eye cups, so that different sizes of apertures may be used. This is accomplished by carrying a gradu-

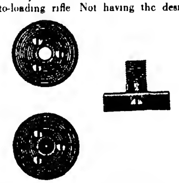
Left· Variable aperture peep sight made in 1746. Either rectangular or round opening may be used. *Right:* Fore-runner of the telescopic sight (17th Century)

A hole through the top of the lizard's head serves as a peep sight

ated group of eye cups or through the use of the *Merit* iris-shutter disk But on a rifle of 1746 we found a sort of pre historic application of this variegated disk idea in a small metal box, fastened lengthwise of the top of the barrel The shooter could sight through a rectangular opening 1/4 by 3/8 inches, or he could drop a hinged block of metal into a slot in the metal box and utilize the round aperture 1/16 inch in diameter which had been bored in the hinged block

While the first practical peep sight was made by the Lyman Gun Sight Corporation in 1807, which, with only minor improvements, is still known as "Lyman No 1, this device for improvement of target shooting did not receive much impetus until after the Civil War and the concurrent European military struggles It was not until 1911, however, that Col Townsend Whelan, in collaboration with other authorities and the Lyman people, worked out the first practical micrometer receiver sight, permitting minute adjustment for windage and elevation.

It remained for Ralph Albertson, of the Merit Gunsight Company, to bring about one of the latest developments in rear peep sights Albertson, a Californian, says he used to "get a big kick" out of hunting the western jack-rabbits on the run with a 22 auto-loading rifle Not having the desired



Left · Variable aperture Merit sight closed and open *Right* Side view

success at this with conventional open sights, he built a special peep sight and equipped it with a series of eye disks of varying apertures. While these disks were interchangeable without changing zero on the rifle, Albertson decided it was a nuisance to carry a pocketful of accessories, together with canteen, lunch, and gun So, having had many years experience in fine tool and die making, he set about to produce a peep sight equipped with an iris shutter, operating on the same principle as the diaphragm of a camera.

After several years of experimentation, the Merit iris shutter of today not only answers the problem of variation of sensitivity of individual eyes to light, but also obviates the necessity of carrying a series of disks providing different apertures for different conditions Merit disks are made for use on Lyman, Redfield, Pacific, Vaver, Marble Goss, Remington, Savage, Winchester, Stevens, and any other sights using 7/32-40 thread for disk mounting and taking a disk 1/2 of an inch or larger in diameter.

Gun Collectors, Please Note—

WHEN we started chatting about antique firearms in the December 1939 issue, we had no idea that we would uncover so many would-be amateur gun collectors among our readers To those of you who have written for information, we hope the replies have been helpful To those of you who haven't written and would like to, we say again that our mail box is of very generous proportions And, to those of our readers who have already established themselves as collectors of old guns, may we suggest that for the benefit of the many neophytes who aspire to reach your status you drop us a line, giving any suggestions you may have which might be helpful in starting a collection of antique firearms?

There are, of course, two primary factors in establishing collections of any items, be they weapons or scrap iron, learn to know the various types or specimens together with their values, and, advertise yourself For the first, there are books, current periodicals, catalogs of amateur and professional collectors, and association with fellow addicts For the second, Charles Edward Chapel summed it up nicely when, in his book, "Gun Collecting," he wrote, "—to start building a gun collection, look in old attics and barns, visit the junk shops and second hand dealers, tell your friends and relatives you are a gun collector, and write to all the gun dealers for their price lists and catalogs"

We can furnish you with lists of books and periodicals, tell you where to write for catalogs, and provide you with names of associations of amateur collectors We may be able to answer questions concerning ancient firearms, as we have access to several sources of information, and we'll be more than glad to act as a sort of clearing house between those collectors who have obtained a start and those who thus far have only the idea and the ambition May we hear from you "old timers"? Perhaps some of the newer collectors would like to effect trades or make purchases.

Pot-Shots

AT THINGS NEW

WINCHESTER REPEATING ARMS Co offers Model 75, a new five shot, box type magazine, bolt-action sporting rifle, chambered for .22 Long Rifle rim fire cartridges only, and equipped with same receiver, bolt-action, and speed lock as the well known Winchester 75 target rifle The new 75's barrel is tapered with forged front sight ramp and is shorter, being 24 inches, as compared to 28 inches in the target gun. Walnut stock is equipped with sling-swivel bows. It has shotgun butt, with steel butt plate, checkered pistol grip and forearm, and stock dimensions are· length of pull, 13½ inches; drop at comb 1 9/16 inches, at heel 2 9/16 inches. Standard model weighs approximately 6¾ pounds.

Conducted by JACOB DESCHIN, A.R.P.S.

Positive-Negative Design

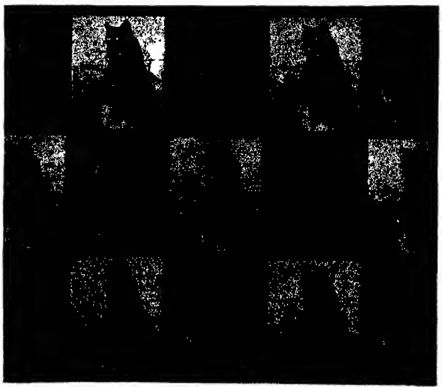
As everybody knows, paper negatives may be made from paper positives (prints) in exactly the same way as photographic prints are made from regular film negatives, either by contact printing or by projection in an enlarger We shall not now take up the subject of making prints by the paper negative process, as our sole purpose is to show how photographic designs either for murals or less ambitious uses may be achieved by utilizing in the decorative scheme both the positive and the negative print.

The subject chosen for the design here illustrated is that of a lynx photographed between two bars of its cage in a New York zoo The pose of the subject—looking toward one side of the picture rather than straight ahead—suggested the possibility of a design in which a number of prints would be made by enlargement, followed by the making of an equal number projected in reverse This latter would have necessitated projecting the negative image with the "glass" or back side toward the easel instead of the normal emulsion to-easel position Thus, when mounted, lynx would face lynx all through the pattern However, this did not seem to offer much promise as it suggested the possibility of dull monotony.

The next thought was to make positive lynx face negative lynx, in this way retaining the original idea yet varying the visual appeal by alternating the tonal appearance of the positive with the distinctively different negative print. The result, we believe, has justified the means

For the purpose of our illustration, we used the dimensions 3 by $2\frac{1}{4}$ inches for the print, but the size you select, should you decide to do something along these lines, would depend on the purpose to which you intend to put the design. The larger the space you will want to cover the greater will be the size of the print. It is suggested, however, that the smaller these prints are, for any given space area, the better will be the general pattern effect. A large number of small prints will be more effective than a smaller number of larger prints In the latter case the observer will be so taken up with studying the individual prints that he will fail to get an impression of the pattern as a whole.

After the required number of prints had been made up, washed and dried, one of the prints was selected for making the paper negatives by means of contact printing We say one of the prints, actually *any* one of the prints was as *good* as the next one for this purpose, since one of the important things to look out for in this type of work is that all the prints should be uniform in



Decorative scheme using positives and negatives in diagonal design

Positive *(left)* and negative prints used in the wall decoration, slightly reduced

appearance—exposed and developed for exactly the same length of time. The positive prints had been exposed "bleed" fashion, that is, without showing any white borders, to exactly the required dimensions, so when contact paper negatives were made, they were exact duplicates of the positives in their outside dimensions.

The mounting of the positives and negatives proved to be the most fascinating part of the job. Desiring a black background we used a sheet of black bristol board, which was ideal for the purpose. We allowed a quarter of an inch from top and side and ruled these off in pencil to provide a guide for starting the mounting of the pictures from the top horizontal row and the extreme left-hand vertical row. From there on we spaced the prints about ⅛ of an inch apart. Incidentally, a few extra positives and negatives were printed as a precaution against possible spoilage. The edges were lined up as nearly as possible to maintain the ⅛-inch separation throughout. However, in a hand-made proposition of this kind exactness is not to be expected nor is its lack of much consequence. Reasonable exactness is all that one can hope for.

The arrangement of the prints is very simple: positive faces negative throughout. Positives and negatives run diagonally through the pattern, but no positive is ever strictly adjacent, that is, above or below or to either side of a positive; and the same holds for the negatives. This may be seen by studying the reduced reproduction shown here.

If a small area is to be covered, we would suggest making all the necessary prints and negatives directly. In the case of a larger area, however, it may prove labor-saving to make a small panel, copy it and from this copy make any desired number of prints, which will be joined to cover the designated area.

Prices Come Down

PRICES of imported cameras naturally soared when war was declared, due to difficulties of obtaining adequate supplies. Now, however, according to Burleigh Brooks, well-known importer of cameras, several large shipments have been received from abroad and prices of his line of equipment have been reduced to points approximating those in effect before September 5. In some cases, the new prices are even lower than before that date. The lines affected by this readjustment include Rollei, Dolly, Foth Derby, and Bee-Bee cameras, as well as Schneider lenses.

High Contrast Subjects

ON those occasions when pictures are desired or must be taken under lighting conditions not sufficiently well balanced to come within the range of tones capable of being recorded by a film emulsion, it is still possible to make a satisfactory job by proper development. Pictures taken at night outdoors are one type; another type includes subjects involving both dark and very bright objects. An effective method is to develop the negative in a formula from which the hydroquinone has been omitted. This formula is usually referred to as metol developer because of its soft-working qualities and its ability to bring out the shadows in a negative. Hydroquinone, which favors contrast, having been left out, the highlights come up more gradually than they would with the regular metol hydroquinone combination, thus giving the metol an opportunity to produce full shadow detail without the danger of harsh highlights.

Counting Seconds

FOR short exposures under the enlarger, it is difficult and somewhat bothersome to watch the darkroom clock. Anything under five seconds duration is hard to follow without holding the clock in the hand. Therefore, most workers when desiring or obliged to make very short exposures in enlarging resort to the "mumbling" system, repeating at an even pace some two-syllable word which, when coupled with the number of the second, takes just about one second to say. One worker will use Lindy 1, Lindy 2, and so on, another will choose a different word. The word used does not matter, of course, just so it does the trick.

Black Lines and Spots

THERE'S more than one way of eliminating those pesky black lines and spots from prints, we learn from *The Gevaert Sensitizer*. As you know, a white area is

fairly simple to work on but a black one often appears almost hopeless. What the present suggestion does is to provide a small white area instead of the black line or spot. Make up the following solution:

Copper sulphate	40 grains
Potassium bromide	40 grains
Water	1 ounce

Apply with a small spotting brush to the black spot or line The black will gradually disappear, leaving a greenish spot. Now slide the print into a solution of plain hypo and leave it there for 10 minutes. Wash and dry If the spot is very tiny a little of the copper sulphate solution can be applied with the point of a needle When the print is dry, fill in the resultant white areas with a fine brush dipped in India ink or black spotting color.

Amateur Characterization

A CLASS of camera subject matter that is generally overlooked is that of exploiting the histrionic and characterization talents of members of your family and friends It need not take more than just average ability and imagination to invent a suitable "get up" for a particular subject, or you may have some idea in mind and

"The Old Maid"

look around for the person who gives promise of fitting into your planned role. An example along these lines is that of "The Old Maid" illustrated here The young lady used to be in amateur theatricals at one time, so had some idea of the requirements. She put on a dark makeshift jacket, stiffened a piece of old lace to wear around her neck, and made up her face to give an impression of utter plainess Cocking her head to one side completed the total impression.

Close-Ups From The Hand

WHEN shooting at such short range as a foot or so, while employing a close-up lens attachment, not only is the focusing

very critical, but, after measuring the appropriate distance, not everyone is able to keep the measured distance while holding the camera in the hand We recently had occasion to use a miniature camera equipped with a supplementary close-up lens We wanted to use it in the field and did not wish to be bothered with a tripod since the camera was to be used in daylight only. With the lens mount fully drawn out, the distance from lens to object was 15 inches; with the distance scale on infinity, the lens-to-object separation was 11 inches. We solved the difficulty simply by cutting a twig 11 inches long and another 15 inches long In operation, all we had to do was set one end of the stick near the lens, and the other end next to the small subject, being careful, of course, not to include the stick in the picture

WHAT'S NEW
In Photographic Equipment

If you are interested in any of the items described below, and cannot find them in our advertising columns or at your photographic dealer, we shall be glad to tell you where you can get them Please send a stamped envelope with your request

Mansfield Single Solution Color Toners ($1 95 for assorted kit) New kit package includes a bottle of each color—blue, brown, green, and magenta Ample solution provided to tone hundreds of 8 by 10-inch prints Procedure Print to be toned is submerged in diluted toning solution where toning action may be watched, when desired color is reached, print is removed for washing to clear highlights Manufacturers say: "Amateurs who would like to experiment with toning can secure sample for 10 cents to cover cost of packaging, and so on Samples of all four colors for 35 cents."

Agfa Memo Speedgun ($14 50) Designed and fitted for use with Agfa 35mm Memo camera Similar in design and construction to Mendelsohn Speedgun Provides accurate synchronization at all camera speeds and with all types flash lamps Provision made for extension wiring to additional flash lamps, safety catch to prevent accidental exposures; adjustment of both reflector position and synchronizing control for different sizes and makes of flash lamps

F-R Precision Range Finder (black, $5; chromium finish, $5 75) Distance meter for amateur still and movie cameras Shows in large, luminous field two separate and distinct images when range finder is not in focus When smaller image is in exact synchronization with larger image through manipulation of micrometer thumbscrew, meter is in exact focus. Works from two feet to infinity.

Spencer Model MK Delineascopes ($22 50 to $58.50): Group includes models using 100-watt, 200-watt, and 300-watt bulbs Protection from heat provided by adequate ventilation system in 100-watt model; heat-absorbing glass in 200-watt; and fan cooling attachment plus heat-absorbing glass in 300-watt model. Lamphouse cover hinged, permitting easy access to bulb or condensing lenses. Condensing lenses easily removed for cleaning. Also available: Film viewing device for viewing strips of films preparatory to making up individual slides Fan-cooling unit operated by universal motor for 115-volt alternating or direct current with rheostat to control speed of fan Spencer projection lens of five inch focal length, aperture $f/3.6$ Delineascope using 100-watt bulb designed for home use, 200-watt and 300-watt models for small auditoriums and class rooms.

DeJur Amsco Chrome Satin Finish Range Finder ($5 50 complete with sling, genuine leather case, and accessory clips) Utilizes superimposition image principle Has extending viewing eyepiece Focusing achieved by micrometer ball bearing adjuster revolving in bronze bearing Will fit all cameras

Cord Type Braquette ($1) · Framing device adjustable from one inch to 36 inches—"large enough to hang a mural" All aluminum or assorted in black, red or gold

Lafayette Superior Easel ($4 59) Base of steel, with rubber strip bottom Finish black enamel with chrome trim, except for 11 by 14-inch focusing surface, which is white Lumislite bordered by inch scales Masking guides easily adjusted and locked, alignment maintained by guide frame at "free" ends

Kodak Control for Photoflood Lamps ($4 50) Designed to prolong life of lamps and assure comfort for subjects while picture is being arranged Compact metal box less than six inches square Control accomodates up to six No 1 Photofloods or up to three No 2 Photofloods Plugs into any power line of 100 to 125 volts, either A C or D C, four sockets provided Lamps may be burned at about half voltage through use of "dim" switch setting, when heat and glare are greatly reduced Either left hand or right hand group of lights can be turned on or off independently of opposite groups With control at camera position, photographer can shut off or alter lighting without moving from lamp to lamp

Fotocraft Slide File ($3 25) Made of seasoned wood, natural finish Capacity 80 two by two-inch glass slides Has self-contained illuminated viewer operated with button switch.

Tankometer ($1) New type thermometer designed for use with spiral type reel tanks Lower end notched to engage reel, thus serving as rotating rod Thermometer encased in plastic housing for protection against breakage. Scale of stainless steel Accuracy guaranteed within one half of one degree

F-R Plastic Printongs (58 cents a pair) One red, one black. Sturdy meshing grips prevent slipping, special stops to prevent tongs from slipping into tray

Lafayette Hi-Lite Spot ($15 89 complete with lamp): Features ample illumination, lightweight, easy adjustment and operation, wide focusing range Case of unbreakable die-cast aluminum Mounting of universal yoke type adjustable in all directions. Focusing by dial at rear of case, permitting adjustment of beam through entire range from sharply defined spot to diffused

flood-lighting. Fresnel lens of heat-resisting Pyrex; beam concentrator of non-tarnishing chrome-plated aluminum. Pre-focus type bulb used operating at 3200 degrees Kelvin specified for color photography, maintains constant illumination throughout rated life Illumination said to be equivalent to conventional 500-watt spot. Eight-foot telescoping stand available.

AGFA DARKROOM LAMP AND FILTER OUTFIT ($1 95) · Includes Agfa 3¼ by 4¾-inch safelight lamp housing and socket; A3 green filter, A6 yellow-green filter, A7 red filter Filters, all 3¼ by 4¾ inches, designed to provide maximum visibility with complete safety when correctly used and fitted with standard 10-watt frosted Mazda lamp Filters for panchromatic and orthochromatic films and for all papers

WINDSOR EASEL ($7 50). Features· Constant center, with fixed paper stops for 5 by 7, 8 by 10, 11 by 14-inch prints, as well as smaller and intermediate sizes, steel construction throughout, assuring immunity from warping out of alignment, washable in soap and water, white borders from ⅛ to 1¾ inches achieved with smoothly moving masking blades, finished in flint gray, without gloss; baked-on white focusing area measures 11 by 14 inches, rules, with black numbers on contrasting ground, measure both from center of paper outward and from paper corners inward, ribbed rubber strips on easel bottom prevent accidental "skidding"

WABASH SUPER-N-LARGER BULBS (35 cents to $1): New type self-diffusing enlarger bulb Made of glass scientifically treated on inside by special process to "break up raw filament light rays into soft, diffused light that is distributed evenly and uniformly over entire bulb surface in brilliant, white glow." Five different sizes with wattages ranging from 75 to 500 and lives from 100 to 300 hours.

SUPER OMEGA B enlarger ($77 50 with detachable lens board, no lens) Features negative size 2¼ by 2¼ inches down to 35mm, adjustable negative carrier, set in bellows, permits use of two- or three inch lens with same set of double condensers, negative carrier set in turntable to permit rotation in all directions as well as tilting up and down, illumination (A C. or D.C operation) 110 volt, 75-watt Mazda photo enlarging lamp No. 211; new type dustless negative carrier, horizontal projection attachment, baseboard laminated hardwood 18 by 32 inches; twin-guide micrometer focusing, counterbalance mechanism comprises strong steel tape on enclosed steel spring Lenses available ranging in price from $15 to $45

AGFA HARD RUBBER TRAYS (20 cents each) Size 4 by 6 inches. Made of genuine hard rubber.

ALL-AMERICAN INSTOSCOPE AND INSTOCINE VISUAL-TYPE EXPOSURE METERS. Formerly imported from abroad, now manufactured in the United States, making possible reduction in price to $2 25, including sole leather case. American scale includes American Scheiner as well as Weston Number Speed Ratings. Exposure range from 30 minutes to 1/2000th of a second.

CAMERA ANGLES ROUND TABLE

JACOB DESCHIN, *conductor of our "Camera Angles" department, will answer in these columns questions of general interest to amateur photographers If an answer is desired by mail, enclose a stamped, addressed envelope. Queries should be specific, but Mr Deschin cannot undertake to draw comparisons between manufactured products nor to advise on the purchase of equipment or materials* —The Editor.

Q. **I have a number of two-inch squares of ⅛-inch crystal plate glass, and intend constructing filters, using gelatin films and Canada balsam in the usual method of construction. However, I am in the dark regarding certain details of the process: Chemical catalogs list Canada balsam in the following varieties: natural, paper filtered, dissolved in benzol, dissolved in xylol—extra thick neutral. Which shall I use? Should the balsam and glass be warmed? Is light or heavy pressure used in clamping the glass plates? What is the length of the drying period? Is it necessary to seal the edges against moisture? If so, what is used?—R. J. B.**

A Clear—that is, natural—Canada balsam is specified for this purpose The balsam may be used at ordinary room temperature, but if too thick may be thinned either by adding turpentine or alcohol or, preferably, by heating the balsam slightly in a hot-water bath Moderate pressure is used for clamping the glass plates The filter is then put away under pressure Drying under ordinary temperature will take about two weeks The edges should be sealed in some way to prevent the entry of moisture Thin adhesive such as that used in binding two inch square color slides should serve the purpose.

Q. **In consulting the speed ratings of various films, I notice that the rating for the same film when used in artificial light is usually slower than it is for daylight. Can you tell me the reason for this?—J. L. G.**

A. As you probably know, film emulsions are more sensitive to blue than to any other color of the spectrum Sunlight is rich in blue rays, but tungsten light sources lean towards the red A comparatively greater exposure is therefore required for the same film used under tungsten lighting conditions to compensate for the illuminant's deficiency in blue. The extent of this deficiency varies with different film emulsions.

Q. **I have a miniature camera which takes 35mm film; this comes in small metal containers. In the course of taking the film out of the container, it becomes scratched; how can this be prevented?—J. W.**

A. We presume that you refer to the storage of the negative roll in the metal container. The raw film, as you know, is well wrapped besides having the extra protection of a few sheets of literature around it So far as the negative roll is concerned, scratching from this cause is easily remedied simply by rolling the film strip up to a measurement reasonably smaller than the inside of the container, and slipping a small rubber band around the rolled strip to prevent it from unfurling in the container.

Q. **With a lead pencil I have drawn a rectangle on the ground glass of my camera to indicate the limits of the exposed area of negatives. Can you suggest a better instrument or material for marking on ground glass—something that will make a darker mark and will adhere well under working conditions?—F. S. D.**

A Lead pencil markings will naturally rub off in a short time Professionals often mark or rule the ground glass with a sharp instrument These lines are easily discernible in use Another way is to use black drawing ink, but the disadvantage of this is that, unless your lines are to indicate the extreme borders of the film dimensions, the black lines might interfere with your image, if you wished to work outside the marked limits

Q. **Will you please send us a formula for simple photographic emulsion?—J. V. M., Jr.**

A. E J Wall, in his "The Dictionary of Photography," cites the following Abney formula for an emulsion for rapid plates

Potassium iodide .	5 grains
Potassium bromide ..	135 grains
Nelson's No 1 Photographic Gelatine .	30 grains
Silver nitrate . .	175 grains
Hard gelatine and No 1 gelatine (equal parts) ..	140 grains

For details, we suggest consulting Mr Wall's "Dictionary" as well as his standard work on the subject, "Photographic Emulsions," and Abney's "Instruction in Photography."

Q. **I should like to know where I may find reliable instructions for simple "direct positive development."—S. N.**

A. Write to the Eastman Kodak Company, Rochester, New York, for information on the processing of their Positype paper.

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MODERN MIRACLE MEN

By J D Ratcliff

MEDICINE is the central subject of the first part of this book, which discusses in free, running style, without more technicality than the average layman cares to read for entertainment combined with education, the outstanding developments of medical miracles pneumonia and its treatments, vitamins, meningitis, and sleeping sickness and the attempts to conquer them and other diseases The second half is devoted to the revolutionary changes that science is bringing to agriculture (311 pages, 5¾ by 8½ inches, 15 illustrations)—$3 10 postpaid.—*A G I*

HANDBOOK OF PHOTOGRAPHY

Edited by Keith Henney and Beverly Dudley

AN attempt has been made—and successfully indeed—to augment in one convenient volume the many books which are now available covering the various aspects of photography With the help of 23 photographic specialists, the editors have compiled a thorough exposition of the serious aspects of the technique of photographic processes and the scientific basis underlying photography and its applications This is in every respect a serious textbook that delves deeply into the *whys* and *wherefores*—no picture book in any sense of the word—concerning itself more with technique than with final results. (872 pages, 6¼ by 9¼ inches, numerous line drawings and a few pertinent photographs)—$7 60 postpaid.—*A P P*

COMMON OBJECTS OF THE MICROSCOPE

By the late Rev J G Wood, revised and rewritten by W J Ferrier, F. R. E. S

IF the reader does not object to its old-fashioned appearance, this book will show him what to do with his microscope what to look at and where to find it It is an old book that received much acclaim in its day, now revived and partly furbished for modern use Heretofore, microscopists have been paying more than the original price to get second hand copies of the earlier editions Now it is inexpensive. The diagrams look old fashioned but they "get there just the same," and the substance of the book is something that does not change. Compass Elementary optics of the microscope, examination of common objects such as cells, plant parts, algae, desmids and diatoms, insects, blood corpuscles, and a host of others There are 12 color plates each showing numerous objects, in addition to 28 regular figures (184 pages, 4¾ by 7¼ inches, illustrated)—$1 85 postpaid—*A G. I.*

WHAT ENGINEERS DO

By Walter D Binger

WHILE not exactly a guide book to determine the field for future engineers, this book could, nevertheless, be used as such It is not technical but rather a lucid discussion of many kinds of engineering activities First, it gives the background of engineering, dating to primitive times, and then, step by step, it carries on to a complete discussion of modern practices. Many clear drawings are included to show processes or tools and equipment that are used This would be particularly valuable for the youngster who intends to take up some branch of engineering (304 pages, 5½ by 8¼ inches)—$2 85 postpaid—*F D M.*

LOVE AT THE THRESHOLD

By Frances Bruce Strain

DATING, romance, and marriage—this is the scope of this work for adolescents. It is a practical book, dealing with the world of today as it is and not merely as some of us wish it were, that is, it assumes that your adolescent is in that world, which will remain as it is, and therefore will have practical problems to meet It's a book your son or daughter will read and like—not preachy or superior. Part I contains points on dating, what to be like in order to please, and all about different types of girls and men Part II is on everyday kinds of girls and everyday kinds of men (how to understand and deal with them), also the "one-and only" stage. Part III is for marriage and is on body mechanisms, fulfillment in marriage, married life, babies in the making. (349 pages, 5½ by 8 inches, 3 illustrations)—$2.35 postpaid—*A G. I.*

THE STORY OF A FACE

By Hillary G. Bailey, F R P.S.

"THE Story of a Face" is the story of producing any photographic portrait from the exposure in the camera and all the thinking that goes on before the "click," to the final print. Mr Bailey considers his book, which is actually a complete treatise on the fundamentals of portraiture in particular and photography in general, a practical formula of procedure. Practical, indeed, it is, with its lucid discussion of such important subjects as lenses, negative and print quality, composition, and full-length portraiture And, more than this, the book is pervaded by a philosophy and point of view that raises mere fact-recording to that higher level where a fact is only a jumping-off point for individual thinking and interpretation (127 pages, 7 by 9 inches.)—$2 60 postpaid.—*J. D.*

PAINTS AND PAINTING

By G C Molleson

THE purpose of this manual is to present a compilation of useful and practical, rather than technical, information about the formulation, properties, and application of various paints This material will be of assistance to the purchasing agent, maintenance engineer, manager, property owner, and others interested in or responsible for the maintenance and preservation of buildings, bridges, equipment, and other miscellaneous structures

Such general information relating to paints and painting has been included as will give the layman or consumer a general and somewhat detailed knowledge concerning those subjects, that will enable him to buy paint suitable for the purpose intended at a reasonable price

The above, taken from the publisher's blurb, appears to be an accurate characterization of this book It contains numerous paint formulas (274 pages, 5 by 7¼ inches, 12 illustrations)—$2 10 postpaid—*A G I*

RUTHERFORD

By A S Eve

FORMERLY professor of physics at McGill University and a fellow worker with the great Rutherford, Professor Eve is best able to prepare the life and letters of that great and eminent genius The book is an intimate mirror to Rutherford, his thoughts revealed in it through innumerable letters interlarded with accounts of his life by the author (451 pages, 6½ by 9½ inches, 23 illustrations)—$5 10 postpaid—*A G I*

GEMS AND GEM MATERIALS

By Edward Henry Kraus and Chester Baker Slawson

THIRD and revised edition of the book of identical title, formerly published under the authorship of Kraus and Holden, and widely known as a standard treatise

FOR OTHER BOOKS YOU WANT, SEE PAGES 106 AND 116

for study and reference on the forms, properties, formation, occurrence, and characteristics of gems and gem materials This is no mere book of inspirational writing about gems; on the contrary, it is a meaty, solid, compact, well organized, scientific treatise of textbook type, dealing with gems in most of the aspects which will interest and instruct the practical amateur collector and polisher It gets down to brass tacks and fundamentals (287 pages, 6 by 9 inches 344 figures and 4 fine color plates.)—$3 60 postpaid —*A. G. I.*

WHAT'S YOUR ALLERGY?

By Laurence Farmer, M. D.

EVERYBODY has at least one allergy Some allergies are pretty serious but many others are more in the nature of annoyances which are usually unrecognized as allergies, you know something "is biting you" but you just don't think of it as an allergy This book, written in layman language, tells what allergies are and how they are diagnosed and treated (234 pages, 5½ by 8 inches, unillustrated)—$2 10 postpaid—*A G I*

MODERN PORTRAITURE

By Stanley R Jordan

ADAPTATION of the technical methods of Hollywood to still portraiture is the basis of Mr Jordan's latest book for the advanced amateur photographer In it he presents complete details on all phases of portraiture photography, including equipment, lighting, make up, posing, and portraits of various types under varying conditions. The large number of illustrations, many with explanatory diagrams, leaves little to the reader's imagination, guiding him through from beginning to end (199 pages, 6½ by 9 inches)—$3 10 postpaid—*A. P. P.*

MIND EXPLORERS

By John K. Winkler and Walter Bromberg, M. D.

SO far as this reviewer recalls, no recent book has so systematically yet at the same time so compactly swept over the field of general psychology as this most readable volume. It starts with phrenology (an early scientific miscarriage), passes to magic and mesmerism, then to Pinal, Todd, Charcot, and Le Maitre, on to Galton, to William James, Cattell, Hall, Yerkes, Watson (behaviourism), Freud, and then a few moderns—stating the principles of the psychology of each fully enough to present its main features yet briefly enough to save the reader from becoming lost in the mazes of detail. (378 pages, 5½ by 8¼ inches) —$3.10 postpaid.—*A. G. I.*

SCIENCE IN YOUR LIFE

By John Pfeiffer

SHORT, compact essays on things scientific—heat, molecules, the telephone, hearing, light, X-rays, atoms, lightning, electrons and so on—compose this little book which would interest any man or youth with an inclination toward scientific subjects. Some of the artist's chapter-head sketches are just a bit absurd, particularly one of a "water-driven dynamo." (109 pages, 5 by 8¼ inches, illustrated.)—70 cents postpaid.—*A. G. I.*

TELESCOPTICS

A Monthly Department for the Amateur Telescope Maker

Conducted by ALBERT G. INGALLS

MOST observatory buildings for telescopes fall into two general categories—the conventional dome and the open-topped rectangular building. Examples of each are shown in illustrations on the present page.

The volume of an observatory dome is directly proportional to the cube of the length of the telescope it houses, hence when B. L. Bradley, 235 North High Street, Salem, Oregon, made a 12½" mirror of $f/11\frac{1}{2}$, with a 13' tube (Figure 2), the 20' dome he built (Figure 1) was a logical sequitur. It is a fine, roomy dome, quite unlike some which leave so little room between walls and telescope that a fat man, or even a skinny one, must become a contortionist in order to get around.

Bradley's dome has a fixed base 7' high, of reinforced concrete 5" thick. Rafters are two-by fours, roofing is 26-gage galvanized iron painted with aluminum. Shutters open a full 6', running on roller-skate wheels. Dome rolls around on ball-bearing assemblies from wrecked cars.

Figure 1: Bradley's big dome

The telescope stands on a heavy, deep concrete pillar. Its mounting has Timken and New Departure bearings, a closely calibrated declination circle, electric lights, and other trimmings. Tube is 14" in diameter. Finder is a 6", $f/5.5$ reflecting telescope. Bradley got the machine work of the mounting done on the well known "you scratch my back and I'll scratch yours" principle. That is, he made the lads of the Salem High School an 8" mirror while they did this part of the work for him.

IN winter, the user of a telescope likes a source of warmth to which he may occasionally flee, while in summer he may want to flee from the astronomer's enemy, the mosquito. Frederick C. Holtz, 2150 Wiggins Ave., Springfield, Ill., has worked out a combination, shown in part in Figure 3, which provides for both. "The general appearance," he states, "is that of a garden house with a flat roof. The roof is supported on rails and can be rolled back, giving a clear view of the heavens. This has the added advantage of quickly equalizing the temperatures and does away with the turbulence frequently observed when looking through the slit of the hemispherical type of dome. Many other advantages will also occur to those who have had experience with both types." [There has been many an all-night argument between exponents of the two views; it's like that other problem which are better—blondes or brunettes?—in final analysis insoluble.—*Ed.*]

Figure 2: The long-focus reflector

Continuing, Holtz says: "The portion over which the roof rests when the observatory is in use has been made into a screened-in porch which provides ample room for entertaining guests while they wait their turn to view the celestial wonders. This is augmented by an outdoor fireplace which provides hot dogs and coffee to keep out the cold.

"The telescope (Figure 4) is a 6" refractor constructed by the writer," Holtz adds, "which ultimately will be replaced by a 20" reflector—though it must be said for the refractor that its fine definition and many good points could hardly be improved upon. I have made a 3", a 4", and this 6" refractor, also two 8" reflectors, one with quartz mirror."

Holtz says Steinheil and Conrady are his bibles, likewise Hastings' "Principles in Geometrical Optics," which he calls a wonder of a book.

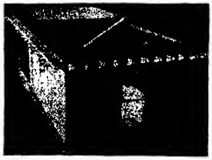

Figure 3: Stars-with-Hot-Dogs, Inc.

UNCOMMONLY trim workmanship is characteristic of things telescoptical made by D. Everett Taylor, 191 Prospect Street, Willimantic, Connecticut, the author of the chapter on the construction of the metal parts of a refracting telescope in "Amateur Telescope Making—Advanced." Other Taylor jobs—eyepieces, for example—have been described in this department. Now, at our request, Taylor describes one of his recent pieces of workmanship, as follows:

"On page 242, 'ATMA,' Haviland shows a spherometer, and on page 250 he recommends a dial indicating edge or thickness gage. These two items of his are directly responsible for my making the combined spherometer and edge gage shown in three aspects in Figures 5, 6, and 7. For those who aim at a high degree of accuracy in making a lens, this combined instrument demonstrates itself as a necessity instead of 'almost a necessity.' The edge of the thickness gage is for measuring the edge thickness of a lens, while the spherometer gives the sagitta or depth of curve, in decimals of an inch, and is used in connection with the two formulas from page 243, 'ATMA.' The combination gage is made of a 3 5/8" x 3/8" brass disk, ¼" stainless steel rods, and 1" x 9/16" brass rod holder clamps. The Starrett dial gage is graduated to 0.0005", with a side bezel which simplifies lifting the dial spindle at top. The brass disk is edged, finished on both sides, and a 2" and a 3" V-line circle is machined on the face of the disk. These circles are divided into sixths (60° apart), drilled and tapped with 3/16" x 32 thread. The edge of the disk is also drilled and is tapped with the same size thread, the holes 60° apart and located between or at 30° relative to any hole on the face of the disk. Each rod holder clamp is machined, is drilled for a ¼" rod, threaded for a screw, then split with a thin hack saw.

Figure 4: Eye end, 6" refractor

"The use of steel balls in the 45° tapered depressions has been abandoned. Steel balls are not sufficiently accurate. A variation of 0.0007" has been noted in the di-

Figure 5: Taylor's combined gages

Figure 6 Rear aspect of Figure 5

Figure 7· The spherometer set-up

ameter of a steel ball Therefore, the tapered depressions are not required. Three steel posts threaded for the holes in the disk, and having highly polished domes, are used. Each of the radiating rods has one threaded end, while the guide rods have highly polished ends Used as an edge gage, this device will take lenses from 2" to 6" in diameter.

"Figure 7 shows the instrument set up as a spherometer on a 6" optical flat, and adjusted to zero. To use it as a spherometer, three points of contact should be in line That is, a domed post should be screwed on the under side of the disk, into a hole on a V-line circle at each end of the 2" diameter or 3" diameter, with the spindle of the dial gage passing through the center hole from above, as shown in the photograph. This arrangement locates the three contacts *in line*, thus giving a reading of greater accuracy than would be obtained if three posts were located 120° apart on a circle, with the spindle in the center. It may facilitate in adjusting the spherometer on a flat if, in addition to the three contacts in line, as just described, a third post is screwed into a hole at either side, to steady the instrument while setting the dial. The extra post is to be removed when the spherometer is being used.

"It is doubtful whether a lens can be brought to a complete polish on a machine, without showing some degree of turned edge; which in equal measure would discount the performance of the finished objective if it were not in some manner eliminated. The late world-famous Alvan Clark declared, on the authority of an old lens

THE BEGINNER'S CORNER

NO thrill an advanced amateur telescope maker is likely ever to receive will out-thrill the one felt by the novice who, after slaving over his first mirror and perhaps wondering all along whether *his* really will perform adequately, as others do, discovers the usual success Anthony Minski, 36 Chadwick St, Paterson, N J, describes this thrill in a spontaneous letter mailed immediately after such a first preliminary try out "After many trials and tribulations I have at last finished my 6" mirror I placed the glass, still unsilvered, in its tube and with no little trepidation prepared for the worst. I focused on the Sun and, as I did, the orb became more and more distinct; till at last it stood in all its glory, a clean-cut disk. The sunspots stood out sharply And then, when it grew dark, I focused on Jupiter, which showed with its tiny satellites in astonishing clarity Saturn, too, focused beautifully Then I viewed various stars and these stood out as brilliant points of light, the fainter stars tiny pin points in the background Orion's nebula showed without blur or haze" This man must have fallen asleep that night with a happy smile on his face! One place and another, it happens ten times a night as first telescopes are given first try outs this eager anticipation, these dark misgivings, the final jubilation.

BOYS seldom tackle telescope making, and more seldom stick till the finish—it's not juvenile work and it requires more

patience than most youngsters possess Now and then, however, we receive a photograph like the one in these columns, usually from a lad of better-than-average gumption. Rudolf Kohlmeister, 1709 Taraval St., San Francisco, Calif, is the maker of this 6" Newtonian reflector and he writes: "I was 11 when I started it and it took me from Oct 13, to June 15," Well, Rudolf that is approximately eight months, but we know of instances in which grown men have failed to finish their telescope after eight years, though eight weeks is about average for a man "The tube," Kohlmeister continues, "is of heavy cardboard wrapped in canvas The rest is iron scraps and pipe Grinding and polishing required 54½ hours" A boy of 11 who sticks to anything as long as 54½ hours is likely to get somewhere some day Your scribe recalls a youngster who similarly stuck, made his telescopes, went through high school and college, and is now a professional astronomer That was John W Evans, of Mills College, Oakland, California

TELESCOPTICS

(Continued from preceding page)

maker, that the outer 10 percent annulus of a lens should not be allowed to function Which is the better practice, to grind the turn-down away or to cover it up?

"If Clark's dictum is followed, the required size of glass blank for a lens would be the same in either case After doing the fussy work required in centering a lens on a mandrel, to grind off a 10 percent annulus would take probably less time than expected While this grinding would add to the scratch hazard, it would assure a crisp edge and improve an otherwise perfect lens If the outer 10 percent annulus is to be covered, this should be done with authority and permanence, by machining the inner flange of the cell to the required width or depth.

"It pays handsomely to start with flat, parallel faces on crown and flint blanks These blanks should be pitched or balsamed into close contact, then precisely edged as a combination, to the desired diameter By grinding the curves on crown or flint so that the edge thickness does not vary more than 0 0005", the optical center of the lens will automatically be established—and probably with greater accuracy—compared with the result of the tedious conventional practice which depends on reflection and visual judgment"

HAVING purchased a 20½" Pyrex mirror blank, the Springfield (Mass.) Telescope Makers—Carl F Alsing, president, N Main St, N Wilbraham, Mass.—cast about for ways of parallel facing it One of them owned an old safe lor which he had no use because he had nothing to keep in it, and this was converted into a steady support for the grinding spindle Figure 9 shows the disk on this rough rig while its faces were being ground parallel, as it was 3/8" thicker on one edge than the other, and Figure 8 the 20" by 4½" finished blank with upper face roughed out to approximately the ultimate local ratio, or 5 5. "We did the edge with the blank pitched to plywood and mounted up grindstone fashion," Alsing states

IN his new book about the 200" telescope, entitled "The Glass Giant of Palomar," David O Woodbury discusses the methods used for rotating observatory domes At Yerkes and Lowell the domes were pulled around by cables wound on a drum At Mt. Wilson the big dome rests on wheels geared to motors At Palomar, however, there are two pairs of 5 h p motors, one pair of which is shown in Figure 10, a photograph

Figure 8: 20" disk ready for fining

Figure 9. Rough rig for rough work

by Major Martin D McAllister of the Municipal University of Wichita, Wichita, Kansas The vertical drive shafts carry solid rubber truck tires held to the bottom band of the dome by means of springs and friction As shown in Figure 10, they make contact with the dome through a narrow opening in the top band of the fixed base. This dome drive also acts as a brake or clamp for holding the dome, otherwise the

Figure 10: The Palomar dome drive

unbalanced leverage of the opened shutters with a breeze blowing would turn it, even if it does weigh as much as a 12 car train of passenger cars (1000 tons), for the two rings on which it rotates, made of railroad rails, were ground precisely level.

A MONTH ago we hinted here a few facts about the new Gaviola test for optical surfaces Before offering a description of it we propose to wait to see how it shakes down in actual practice in the hands of the average worker. Since it deals in amounts about as much smaller than the ordinary Foucault test as the latter deals in amounts smaller than precision machine work, its use obviously will be confined pretty largely to amateurs who have developed high skill. If fine machine work today involves precisions of 1/20,000 of an inch, ordinary mirror work has dealt in precisions of about 1/400,000 of an inch. The Gaviola test deals in precisions of about 1/4,000,000 of an inch. Its user must be expert enough, not alone to perform the measurements, but to control the actual surface in the same degree of precision—all of which hath perhaps a supercilious sound to it. Hence, since the amateur has intellectual curiosity, he will want to know how the new test works, anyway.

CURRENT BULLETIN BRIEFS

(The Editor will appreciate it if you will mention Scientific American when writing for any of the publications listed below.)

ADVENTURES IN CONVERSATION is a 24-page illustrated booklet that deals with the art of conversation and the stimulating effect which it can have on every-day life. A good conversationalist can turn a dull subject into one that sparkles, can talk interestingly with conviction, can develop a personality which otherwise might be warped. The pathway to developing the art of conversation is found in this booklet. *Conversation Institute, 3601 Michigan Boulevard, Chicago, Illinois.—Gratis.*

HIGHWAY TRANSPORTATION REMAKES AMERICA is a 32-page booklet that traces the development of highways from the very beginning down to the present day, and analyzes the many benefits which have accrued to the American people from modern highway transportation. *National Highway Users Conference, National Press Building, Washington, D. C.—Gratis.*

LOOK AND LISTEN, by M. B. Sleeper, is a television handbook for the set builder and service man. Bound with spiral wire, its 96 pages give a complete survey of television reception equipment in its most modern form. An appendix presents a dictionary of television terms. *The Norman W. Henley Publishing Co., 2 West 45th Street, New York City.—$1.00.*

HOW TO TONE PRINTS, by Arthur Hammond, F.R.P.S., is a 72-page paper bound book which gives practical and fundamental instructions for toning photographic prints in various colors. The necessary formulas are included. Several toned photographic illustrations show the results that may be expected. *American Photographic Publishing Company, 353 Newbury Street, Boston, Massachusetts.—50 cents.*

ATLAS SHOP EQUIPMENT is a 72-page illustrated catalog which presents complete information on machine tools and equipment. The latest models of lathes, drill presses, and so on, are described, together with new attachments and accessories. *Atlas Press Company, Dept. 7, Kalamazoo, Michigan.—Gratis.*

INSTRUCTIONS for painting the interior and exterior surfaces of all types of tanks and supporting structures are given in a folder recently made available. Information is included on surface preparation and how to estimate quickly the surface areas and amount of paint required on various jobs. *American Asphalt Paint Company, 43 East Ohio Street, Chicago, Illinois.—Gratis.*

TRAVEL WAYS is a 40-page booklet that lists a multitude of vacation trips by freighter. Its first-page title, "Foreign Lands at Stay-at-Home Prices," sounds the keynote of the whole booklet. It describes freighter traveling, tells of the great values received for every dollar spent. The book is divided into two parts — a complete guide to freighter travel, plus a tour guide to America. The latter includes bus and rail tours. *Harian Publications, 272 Lafayette Street, New York City.—25 cents.*

ENLARGING THE SOLAR WAY is a 23-page booklet that provides essential information for achieving the best possible results with the enlarging process. Contains much practical data of value both to the amateur and the advanced worker. *Burke & James, Inc., 223-225 West Madison Street, Chicago, Illinois.—Gratis.*

THE OBSERVER'S HANDBOOK is an 80-page pocket-size booklet containing an ephemeris of the Sun, data on the planets' position for the whole year 1940 by dates, list of eclipses, data on the sky month by month with four charts, meteor data, double and variable star lists, positions and data for the 259 brightest stars, lists of clusters and nebulae, and other compact data for telescope users. Prepared annually for amateurs by astronomers Chant and Hogg of the David Dunlap Observatory, University of Toronto. *Royal Astronomical Society of Canada, 198 College St., Toronto, Ont., Canada.—25 cents.*

FOOD AND LIFE is the current yearbook of the United States Department of Agriculture under the new policy of making the yearbooks informative and readable. Two-thirds of this 1165-page book deals with animal nutrition - - 36 chapters or articles by scientific authorities. The remainder deals with human nutrition. *The Superintendent of Documents, Washington, D. C.—$1.50.*

CURRENT PHOTOGRAPHY, edited by Herbert C. McKay, F.R.P.S., is the newest addition to the field of photographic publications. The magazine is planned in such a way that it appeals not only to the camera enthusiast but to the casual picture taker as well. Information regarding subscriptions may be obtained from *Klein & Goodman, 18 S. 10th Street, Philadelphia, Pennsylvania.*

45,000 WAYS TO WEIGH is a large folded sheet which illustrates a large number of industrial scales, showing the actual applications of many of them. It gives an excellent idea of the many industrial applications of weight measurement for production control. *Toledo Scale Company, Toledo, Ohio.—Gratis.*

RADIO BUYING GUIDE 1940 is an elaborate catalog, thoroughly illustrated, which lists all types of radio and sound equipment. It would be of interest to all radio service men, amateur radio operators, and those who take pride in constructing high-grade radio equipment for pleasure or profit. *Sun Radio Co., 212 Fulton Street, New York City.—Gratis.*

NUTRITIONAL CHARTS is a 36-page booklet which considers the whole field of diet and its relationship to the well-being of the human body. It deals with, for example, quantities of nutrients required per day, a simple diet plan, vitamin data, composition of various foods, and so on. *H. J. Heinz Company, Research Dept., Pittsburg, Pa.—Gratis to medical specialists and students, nutritionists, and dietitians.*

LEGAL HIGH-LIGHTS

Patent, Trade Mark, and Related Legal Proceedings That May Have a Direct Effect on Your Business

By ORSON D. MUNN, Litt.B., L.L.B., Sc.D.
New York Bar
Editor, Scientific American

REASSURING

MANY of us will be reassured by the implication inherent in a recent decision of a federal court that manure is not an obvious substitute for or equivalent of cereals The decision was handed down in a suit for infringement of a patent for propagating mushroom spawn Prior to the invention covered by the patent in suit, mushroom spawn was propagated by placing a culture in a bottle packed with composted manure The culture was permitted to propagate in the bottle for a period of six weeks or so under predetermined conditions of temperature and humidity During this period the thread-like mycelium of the culture spread throughout the contents of the bottle At the end of this period the resultant product was known as mushroom spawn and was planted in properly prepared beds to produce mushrooms

In the process taught by the patent in suit, cereals such as cracked wheat, whole grain wheat, barley, and rye were substituted for the composted manure and in all other respects the process was carried out in essentially the same manner as the original process. Among other things it was contended by the defendant that the substitution of the cereal for the composted manure did not amount to invention The Court, however, found that the use of cereals resulted in a decided improvement in the spawn and concluded that the replacement of the manure by a cereal constituted invention

RECORDINGS

THE Courts have recognized that interpretive artists have a form of literary property in their renditions Thus it has been held that where a recording has been made of an orchestra leader's interpretation of a song the recording cannot be broadcast over the radio without the consent of the orchestra leader. This principle of law assumed a peculiar twist in a recent Federal Court decision in a case involving a prominent manufacturer of phonograph records and a well-known orchestra leader. The orchestra leader had entered into a contract with a manufacturer, granting the manufacturer the exclusive rights to manufacture and sell phonograph records of his renditions. The contract specifically prohibited the manufacturer from using the records for radio broadcasts. Thereafter, the orchestra leader authorized radio broadcasting stations to broadcast the recordings which were made pursuant to the agreement.

The manufacturer objected to this use of its records and filed suit against the orchestra leader and a radio broadcasting company to restrain them from using the records in this manner The Court found that the orchestra leader "because of his unique interpretation of musical selections, had a common law property right in his renditions" and found that the property right in the recorded renditions had been sold to the record manufacturer Under the circumstances the Court concluded that the record manufacturer was the owner of the recorded renditions and could restrain the orchestra leader and the broadcasting company from broadcasting the recordings

YEAST

IN this department in the June 1939 issue, under the title "Experimentation," we referred to a decision of a federal court with regard to a patent for propagating yeast In that case the patent was declared invalid on the grounds that the process covered therein could not be carried out without further experimentation The decision has now been reviewed and sustained by the United States Supreme Court

The patent in suit related to a process for propagating yeast in which the production of alcohol was reduced to a minimum. The patent suggested that the yeast be placed in a relatively dilute wort Upon the initiation of the process of reproduction, a relatively concentrated wort was added to the original dilute wort over a protracted period of time The patent did not specify the exact times at which additional concentrated wort was to be added nor did it specify the quantity to be added at these times. The patent did state that the wort should be added "at a rate such that not only the alcohol which may have been formed from the quantity of sugar present in the dilute portion of the wort, but also any alcohol which may be formed from the sugar which is present in the added wort, can be assimilated immediately by the yeast." This description was held by the court to be too vague and indefinite, since both the times and manner in which the solution is to be added may be ascertained solely by experimentation.

THERMOSTATIC CONTROL

THE difference between a patentable combination and an unpatentable aggregation was considered in a recent suit for patent infringement involving a thermostatically controlled, house heating system. In the patented system, a furnace having an automatic stoker was utilized and a thermostatic control was provided in the room to be heated and also in the furnace. The thermostat in the room was of the usual type intended to cause the operation of the stoker so as to maintain the room temperature within certain predetermined limits The thermostat in the furnace was intended to cause the operation of the stoker to prevent the fire in the furnace from going out, particularly during warm weather when the thermostat in the room did not cause operation of the stoker at sufficiently frequent intervals to keep the fire going.

It was contended by the defendant that the use of the two thermostats was an aggregation, as distinguished from a patentable combination The Court considered the law with respect to this question and concluded that "the acid test is whether the old elements work together to accomplish a useful new result" If they do, there is a patentable combination. If they do not, there is merely an unpatentable aggregation The Court then pointed out that the two thermostats did work together to perform the function of regulation of the room temperature within predetermined limits. The thermostat in the furnace prevented the fire from going out and in that way enabled the furnace to operate in response to the thermostat in the room and thereby preserve the room at the desired temperature As a result of this co operation, the Court held that the patent covered a patentable combination

HAVANA

FALSE or misleading branding of merchandise is an unfair method of competition and can be restrained by the Federal Trade Commission However, an interesting qualification of the power of the Commission to restrain such practices has been recognized by the courts Thus, where a misleading name has been employed by a manufacturer for a long period of time so as to acquire a secondary meaning quite apart from its original significance, the courts will not require the user of the name immediately to discontinue further use

This principle is illustrated by a Federal Trade Commission proceedings involving the use of the name "Havana Smokers" on cigars manufactured in the United States from tobacco grown in the United States. The Commission contended that Havana tobacco was regarded as superior tobacco and that the name Havana Smokers would mislead purchasers into believing that the cigars contained Havana tobacco A Federal Circuit Court of Appeals, reviewing the proceedings, found that the name Havana Smokers had been used by the cigar manufacturers since 1902 and that in all probability the name had acquired a secondary meaning, quite apart from its original significance, indicating to the public that the cigar was the product of the particular manufacturer In view of this the court was of the opinion that the sudden elimination of the name Havana Smokers might cause confusion among the purchasers of this brand of cigars and concluded that the manufacturer should be allowed a period of two years within which to eliminate the use of the name Havana in connection with the cigars. In this way it will be seen that the public would ultimately be protected against the use of a misleading brand name and that the manufacturer would be permitted a reasonable transition period within which to adopt a new name

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NINETY-SIXTH YEAR • ORSON D. MUNN, Editor

CONTENTS • MARCH

THE peculiar object on our cover is a 16-inch astronomical telescope of the Hartness, enclosed, turret variety, permitting observation from within when winter winds or summer insects bite. It has a massive, slanting, concrete cap that rotates on rolls, carrying with it a diagonal flat mirror (here invisible), a concave mirror at the end of a framework, and a small opening through which the twice-reflected light rays enter the cozy interior On the nearer side is a long steel counterbalance. The photograph was taken at Stellafane, mecca of amateur telescope makers, near Springfield, Vermont, by Robert Cox.

The SCIENTIFIC AMERICAN DIGEST

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50 Years Ago in . . .

Scientific American

(Condensed From Issues of March, 1890)

REFRIGERATION—"Our food supply has been largely increased by the application of apparatus for mechanical refrigeration to ships Our frozen meat trade with New Zealand is of recent development, and it has already reached enormous proportions At present twenty-seven steamers and ten sailing vessels, all fitted with mechanical refrigeration machinery, are engaged in this trade"

FIRE BOAT—"The city of Boston has recently built and put into service a fire boat, designed for use as floating fire engine . . . The pumps . . are of vertical, duplex, double-acting flywheel type. They are divided into two sets, comprising altogether 4 steam cylinders, 10 in by 10 in, and 4 water cylinders of 10 in stroke and 9 in. diameter In the illustration a good idea is given of the service that such a boat can perform In addition to the two four inch streams thrown from her forward deck under perfect control, a number of lines of hose can be carried from the header, so as to deliver water to engines on shore Thus the boat is not merely for the protection of the water front Much useful service can be executed in a belt 2,000 feet wide around the shore line"

TORPEDO BOATS—"Messrs Yarrow & Co have recently completed six first-class torpedo boats of what is now reckoned the standard type The boats are of galvanized steel and are 130 feet long and 13 feet 6 inches broad Their triple expansion engines will indicate about 1,150 horse power, and, with a load of 20 tons on board, will drive the craft at a maximum speed of rather over 23 knots, or nearly 26½ miles an hour"

AMMONIA FROM AIR—"The production of cyanogen directly from atmospheric nitrogen has been made the subject of further investigation by F Breneman which leads to the conclusion that while cyanides and ammonia may be thus produced experimentally, there are as yet insuperable difficulties in the way of adapting those methods to industrial purposes"

STILL WANTED—"Those who have spent a half hour or so trying to ring up a man at the other end of a telephone line, and have found out after much effort that there was no one there, would feel better if there was on the market something which would at once, when a box was rung up, give a signal stating that there was no one to receive a message, and how convenient if some attachment could be devised for communicating the time the person would return to receive the message"

SUEZ—"Night traffic on the Suez Canal has increased very rapidly since electric lighting was started Thus in 1887 there were in all 371 night transits made, but in 1889 this number had increased to 2,454 out of a total of 3,420, or upward of 71 percent of the vessels passing through the canal, and four-fifths of the total tonnage, used the electric light to assist them At the same time the average duration of the passage has been reduced upward of 40 percent"

HORSES—"The horseshoe of the present should be improved There needs to be something which will save the hoof from undue wear and breakage, while at the same time permitting of elasticity of movement when the weight of the body is alternately borne upon and taken from it It is suggested that an improved roadway is needed in this climate, something that will wear as well as stone, be as easy to pull on as asphalt and give the horses' feet a good grip, so that they will not slip even in rainy weather"

ALUMINUM "The aluminum industry is on a firm footing both in Europe and America There have sprung up two distinct lines of manufacture the one a chemical process, and the other strictly metallurgical The former produces pure aluminum, and continues to be a complicated process demanding skill and patience The latter produces only the alloys of aluminum, and has been made extremely simple"

PILLOWS—"The latest fad in England is paper pillows The paper is torn into very small pieces, not bigger than the finger nail, and then put into a pillow sack of drilling or light ticking They are very cool for hot climates, and much superior to feather pillows The finer the paper is cut or torn, the lighter it makes the pillow"

WOOD AS FOOD—"In an address delivered at Heidelberg by no less eminent an authority than Victor Meyer, it is announced that 'we may reasonably hope that chemistry will teach us to make the fiber of wood a source of human food' It must be borne in mind, however, that theory, fascinating and promising though it may be, is not always capable of being followed up by a practical result"

PHONOGRAPHS—"The Automatic Phonograph Exhibition Company, of New York City, has been formed to manufacture, lease, use, and sell a nickel in the slot machine, by means of which the dropping of a coin in the slot will operate a mechanism which will cause a phonograph or phonograph graphophone to produce the sound recorded upon its cylinder, and after such reproduction cause the diaphragm to return to its original position"

NIAGARA "The Niagara River Hydraulic Tunnel, Power, and Sewer Company will now, it is stated, carry out its plan for utilizing the fall of water at Niagara, by building its main tunnel and connecting cross tunnels with wheel pits"

AND NOW FOR THE FUTURE

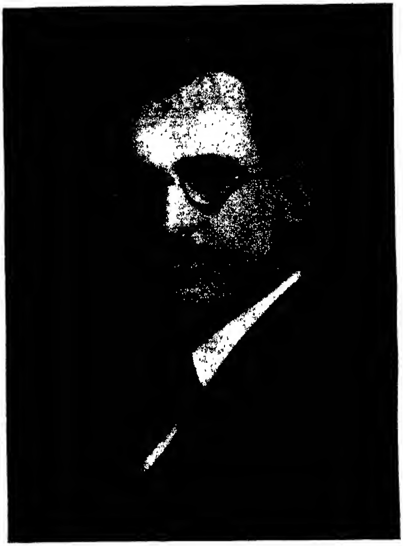
¶Great increases in motor-car mileage will result from developments in gasoline processing By Dr Graham Edgar.

¶Maintaining life in persons who cannot eat By Barclay Moon Newman

¶Model railroading (no "toy trains"), a hobby that is creating rapidly growing interest among adults By R T Griebling.

PLUS other features of wide interest, *plus* our comprehensive Digest of Science and Industry; *plus* Camera Angles; *plus* Telescoptics

Personalities in Science



GEORGE R. HARRISON

PROBABLY few scientists have a closer personal acquaintance with the reticent and elusive atom than Dr George Russell Harrison, Professor of Physics and Director of the Research Laboratory of Experimental Physics at the Massachusetts Institute of Technology

However Dr Harrison seeks the intimacy of the ultimately small not merely for the satisfaction of studying the behavior of particles of matter, but to influence them to contribute to man's health, comfort, and prosperity He knows them from the years spent in the windowless, constant temperature, vibration-proof spectroscopy laboratory at the Institute, which, through his efforts, has become a center of research in atomic science

Several years ago, Dr Harrison decided that the first step toward a closer relationship between pure and applied research in the application of atomic physics to industry was to learn much more about the language and customs of atoms, so that the scientist could distinguish easily among them both tribally and individually. As a result of his work, there appeared last fall the first volume of a series of new tables of spectral lines which contains the accurate, necessary data of the 110,000 strongest lines emitted by the chemical elements Data on the fainter lines will appear in subsequent volumes

Speed and accuracy in gathering these data were made possible by two ingenious machines devised by Dr Harrison Although he says modestly that he was driven to these inventions as a means of escape from old and tedious methods of achieving the same results, his accomplishments are none the less astounding One machine measures and computes the wavelengths of spectrum lines, while the other, known as the interval sorter, determines the energy of atoms and molecules from their spectrum lines, and is capable of making 50,000 subtractions a minute

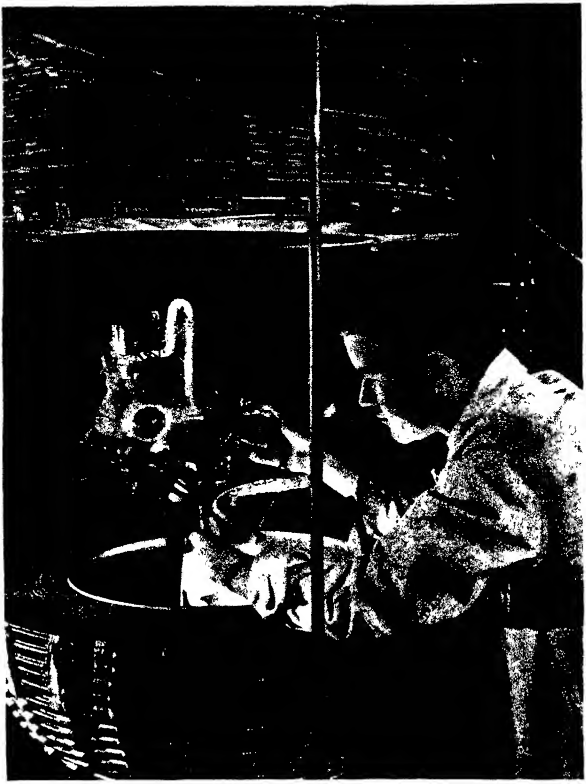
For his "notable work in spectrum photometry and spectrum analysis" Dr Harrison was awarded the Rumford Medals in October 1939, by the American Academy of Arts and Sciences in Boston

Opposed to the hoarding of scientific knowledge, Dr Harrison has become a leading interpreter of research His recent book, "Atoms in Action" is ample proof of his success in the popular interpretation of his work and that of his scientific contemporaries

Born, raised, and schooled in Southern California, Dr Harrison was graduated from Stanford University in 1919 He became an instructor in that institution and continued studies which led to the degree of master of arts in 1920 and doctor of philosophy in 1922. Soon after, he was named National Research Fellow in physics and studied two years at Harvard, after which he returned to the faculty of Stanford as assistant professor, later becoming associate professor

He joined the staff of the Massachusetts Institute of Technology in 1930 and became director of the physics research laboratory when it was founded in 1932 During 1930-31, he also served as research associate at Harvard

Dr Harrison is a fellow of the American Academy of Arts and Sciences, the American Physical Society the Optical Society of America, and the American Association for the Advancement of Science, and is a member of Sigma Xi, honorary scientific society and the American Association of Physics Teachers He was married in 1926 to Florence Bartram Kent



PURE SCIENCE TEAMS WITH INDUSTRY

DR John A Hipple, Jr, of the Westinghouse research laboratories, with a new mass spectrometer built to sort molecules and their constituent atoms according to mass Its outside portion consists of two hemispheres wound with water-cooled copper conductors designed to carry 300 amperes at 150 volts The upper half of the coils hoists off. Inside is the actual spectrometer, which employs a vacuum tube in which ionized particles are differentially affected by the magnetic field Practical applications: Basic knowledge necessary in the design and manufacture of fluorescent lamps and mercury-arc rectifiers, as well as neon and argon tubes.

To fight the hookworm science first fights ignorance Hookworms enter the body through the skin of the feet, if bare

SILENT ENEMIES

Until Sanitation Becomes Universal, Man Will Harbor Internal Parasites and Suffer From Them... Worms... Worms... Worms... Worms... Inside Us

By BENJAMIN ADELMAN

MAN is a walking hotel in which more than 100 species of parasitic worms reside These parasites lodge in his skin, in his muscles, in his lungs, in his intestines and in his brain, while several kinds swim through his blood Perhaps he is victimized by more worm foes than any other animal, for no other creature relishes so wide a variety of food and drink, roams everywhere over the earth, has such an extensive contact with soil, water, and insects, in which worms lurk

Every country in the world, therefore, is plagued by worm diseases and the United States is not excepted Quite a big fraction of America is wormy. For example, about one million Southerners still have hookworm in spite of a 30-year campaign.

Even more common than hookworm is the well-known disease of trichinosis. William Wolf in his article, "Animals Bring Us Disease," in the May, 1939, issue of Scientific American, stated that 16,000,000 people in this country are infected with trichina worms. We can't look down on other countries for being worm-ridden

The strangest class of parasitic worms are the tapeworms, and some of the most remarkable tapeworms are found in Americans Consider the "fish" tapeworm, a wriggling, animated tape running to a length of 60 feet It is not an animal as we understand the term, but a family of 3000 to 4000 individuals or proglottids that are linked together in a long chain Each proglottid leads an independent life, contains organs of both sexes and produces eggs all by itself. This monster worm can lay 36,000 eggs a day! The young worms dwell in the flesh of the fresh-water fish of the Great Lakes which are shipped fresh by the millions every year to cities throughout the country Probably thousands of people are infected with this dangerous worm, which can cause a very severe anemia It is a serious health menace that has had much too little publicity. Tapeworm infestation is easily diagnosed, even in its early stages, by spotting the eggs or proglottids in the human wastes and thus the victims can be readily discovered

The fish tapeworm is not a native It was brought in by Europeans working in the lumber industry of Canada and the Mid-West Through sewage the fish became infected and, since bears, dogs, and otters as well as man eat fish, eradication of the disease is now an impossibility The best hope of control lies in educating the public to eat only thoroughly cooked fish

Fish tapeworm infestation, like other tapeworm troubles, is best treated by carbon tetrachloride One dose of the drug kills 70 to 80 percent of the worms Carbon tetrachloride is the modern successor of a long line of anti-helminthics or worm-killing chemicals. One of the first, dating to the Middle Ages, was male fern Many doctors still use the

extract of the roots. The chief disadvantage of male fern as a remedy is that the patient must be starved for 36 hours before being dosed, and few patients are willing to submit to such treatment. Carbon tetrachloride, on the other hand, can often be taken without preparation

Trichinosis and hookworms are very common diseases but they may soon be surpassed in prominence by a little-known newcomer — oxyuriasis, or pinworm infection Pinworms are home-loving parasites fond of bathrooms and fixtures, but for decades doctors dismissed them as a mere children's disease as trifling as chickenpox. Parasitologists knew that the pest was extremely prevalent, but for the most part pinworms flourished in safe obscurity until three years ago, when the United States Public Health Service started to investigate thoroughly America's most widespread parasite

Every angle of attack — diagnosis, treatment, distribution, and, most important of all, the life history of the creature — was tackled and in three short years enough new facts were unearthed to establish pinworms as a medical problem.

THE first question the Health Service asked was simply, "How many people have pinworms?" Obviously, the whole population couldn't be examined, so the only feasible method was to take samples of the nation and from these estimate the extent of the disease The Service's experts sampled Washington the Nation's Capital, and discovered that, out of 2091 Washingtonians, 861, or 41 percent, were infested! Since pinworms appear to favor the cities, the rate in the country may be lower but it is possible, although not proved as yet, that pinworms may be far more prevalent than most doctors believe, and let it be remembered that pinworms can cause indigestion, insomnia, constipation, and have even been suspected of inciting appendicitis

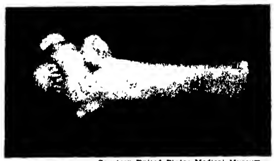
The ubiquitous pinworm achieves his success, not by hard work, but by a clever bit of strategy which sets him at the head of his class Other intestinal worms lay their eggs inside the intestine, therefore their eggs are confined to the human wastes and can be distributed only by contact with them. Hookworm is the classic example The pinworms, contrarily, crawl out of the digestive tract at night, and deposit their eggs on the skin For as long as ten days the eggs may remain alive and in this period are scattered over clothing, bedclothes, furniture, bathroom fixtures, and even dry up and are wafted by the air currents to the walls and ceiling! Small wonder that pinworms run in families!

Yet that's only one difficulty. Give a hookworm victim an efficient drug which will rid him of 90 percent of his guests and he'll usually recover and overpower the rest, but eliminate 90 percent of a pinworm victim's parasites and the unlucky patient will shortly be as badly off as before — pinworms are persistent!

The most hopeful possibility of control lies in repeated treatments The Public Health Service concluded that a course of daily doses for ten days would clear out the parasites and prevent re-infection while the pinworm eggs died out, and, after years of research, hit upon a very promising drug, tetrachlorethylene, which has cured 91 percent of a group of 122 test cases.

The most terrible parasite in this country, fortunately for the rest of us, is found only in a small group of Negroes of Charleston, South Carolina These people are the prey of elephantiasis, the horror that swells the limbs or organs until they reach a tremendous size — hence the name

In India, land of strange sights, elephantiasis sufferers are counted by the thousands Unlike other worm diseases, elephantiasis is not caused by live worms since the living filarial worms in the patient's blood are harmless Their corpses do the damage by blocking up the lymph ducts These swell under pressure and then burst, flooding the lymph into various regions of the body Sometimes the legs become so enlarged that it is impossible to lift them



Courtesy United States Medical Museum

Above A model of the head of *T. solium*, the common tapeworm from pork *Left* Model of the head of fish tapeworm. Thorough cooking kills both of these kinds of tapeworms

Like malaria, yellow fever, and dengue fever, elephantiasis is passed along from present patient to patient-to-be by mosquitoes When the common tropical house mosquito, *Culex quinquefasciatus*, sucks a sufferer's blood, she swallows a few of the infant filarial worms, creators of elephantiasis One day, about two weeks later, the mosquito bites another human but this time she gives as well as takes The larvae slide down its proboscis into the bite One bite is not enough, however Only heavily infested individuals show symptoms and therefore the disease is confined to localities where many cases live close together

The filarial worms can tell time As a rule the baby worms appear in the blood under the skin from about 10 P M to 4 A M. but are almost completely absent during the day. For 40 years scientists have argued over the why and wherefore of this astonishing phenomenon. One group suggested that the embryos are long lived and hide somewhere in the interior of the body during the day, migrating to the surface at night, but this theory doesn't seem very likely An embryo has about as much chance of remaining in a large artery as a man would have of swimming across the rapids of the St Lawrence River Furthermore, the patient's blood vessels would eventually become completely congested and his circulation would stop And finally, why should the embryos hide from the prying eyes of the medicos?

An opposing theory says that all the mother worms give birth at the same time, once a day, every day, and that the infant worms live less than 24 hours. O'Connor found that in the morning the females were filled with embryos while about 2 o'clock all the young had been born Now, *Culex quinquefasciatus*, the common tropical house mosquito, which transmits elephantiasis, bites only at night It seems that the birth of the filarial infants is regulated by the habits of its godfather

No sure cure for elephantiasis is known Scattering the victims, however, is one method suggested for eradicating the disease

In western India the people are attacked by huge guinea worms because, instead of drawing up water from their wells, they wade in to fill their jars. The huge three-foot guinea worm lives under the skin, only the very tip of her body protruding into a tiny ulcer. Whenever water touches the ulcer, the worm discharges a flood of embryos which swim right into the mouths of the nearest Cyclops, a tiny crustacean The native swallows the Cyclops along with his drinking water and another human becomes a slave of the worms.

At first the patient is nauseous, vomits, feels giddy, has fainting spells Attempts to extract the worm by native means may lead to blood poisoning, sometimes necessitating amputation. Doctors ex-

Courtesy United States Medical Museum

Pinworms from a human appendix, magnified 45 diameters Your grandparents, especially your grandmother, who brought up babies, knew the pinworm ("worms"). Later, worms "went out of fashion" but now the United States Public Health Service has demonstrated that they are not to be laughed at

tract the worm in three sections by aseptic methods. Prevention is even simpler than cure but it will be years before the Indians can be induced not to wade around in their water supply.

In the Bible we read that Moses made the likeness of a "fiery serpent" and wound it around a stick to serve as an example to the people of Israel The Elizabethean scholars who translated the Old Testament plainly didn't know their biology, for the "fiery serpent" is actually *Dracunculus medinensis*, the guinea worm Even today native medicine men in Arabia and Africa often pull out the guinea worm by winding it around a stick

THE oddness of worm diseases extends to the way they have been ferreted out Sir Patrick Manson, the founding father of tropical medicine, once spent several years in China doing medical research One day a Chinese visitor called on him and in the midst of conversation very rudely spat on the floor As Manson stooped to clean up the mess after his caller had left, he noticed that the flecks of saliva were bloody. The excited doctor touched them with a slide, slipped it under a microscope and instantly identified a "new" disease—Paragonimus infestation which sickens millions of poor Chinese and Japanese.

Paragonimus is a half-inch long, leaf-like fluke that lives in human lungs, causing coughs, chest pains, and blood-tinged sputum. In fact, lung-fluke infection is usually distinguished from tuberculosis by discovering eggs in the sputum. Drugs are ineffective but transfer of the patient to a fluke-free locality enables Nature herself to heal the sufferer in five or six years.

The eggs spat out by the infested man hatch in water and once in a million times the embryo meets a little fresh water snail and burrows into its tissues Passing through three bizarre transformations the young fluke emerges, crawls over the bottom of the stream or pond until it encounters a fresh-water crab, climbs up and pierces the leg joint, and buries itself in the leg muscles The Chinese and Japanese unfortunately are fond of raw crabs If they were to give up eating this delicacy, Paragonimus plague might disappear in a decade

A similar disease, caused by liver flukes, also troubles the Chinese Here the chain of victims runs from carp to man to snail to carp (Only a certain species of snail will do) The willow-leaf-shaped, one-inch long parasite lives in the liver bile ducts where it can cause anemia, emaciation, diarrhea, and a fine case of cirrhosis of the liver Khaw, a Japanese parasitologist, found that a dye called gentian violet would safely kill the worms Prevention, of course, is obvious As a matter of fact, the Chinese peasants themselves show how the disease can be eradicated The flukes range over most of China yet the disease is confined to the vicinity of the cities of Canton and Swatow, *the only districts of China where raw fish is eaten*

Eating infested food is just one means of acquiring parasites In Australia, infested dogs disseminate a gruesome parasite, the hydatid About two years ago, an Australian sheep rancher lost his little daughter because he was foolish enough to keep hydatid infested sheep dogs. They were dangerous to their masters, even though they weren't vicious, for they carried the seeds of death and these needed only the right environment to start their fatal career. Every day the dogs played with the little girl until one day she swallowed an invisible white speck, a hydatid egg

Within four hours the egg hatched in the child's intestine and the infant worm penetrated an artery where the blood swept it to the brain in which it stuck fast The speck grew until it was a hollow sphere or cyst the size of a golf ball, pressing relentlessly on the brain. Inside it was alive with thousands of infant worms

As the months passed, the little girl complained of frequent headaches, then of failing eyesight. Later her memory and finally her strength declined Once a lively, healthy child, she degenerated into a dull, paralyzed invalid When her desperate parents brought her to the Melbourne Children's Hospital, it was too late She died soon after the operation, a sacrifice to human ignorance

Hydatid cysts normally bulk no larger than an orange but they can expand to huge dimensions. In one case a cyst grew for 43 years until it was as big as a child's head. Another, the "monster" cyst, contained 11 gallons of fluid!

The rarest of all worm infections is also the most startling *Dioctophyme renale*, the giant kidney worm, has been found a few times in human beings, in the process of autopsy The worms usually occur in pairs, the female being about 40 inches long, the male about 10 inches long They spend their lives in the kidneys, destroying the tissues until only a hollow shell is left and the victim dies of blood poisoning Pleasant!

CAN the parasitic worms be defeated? The Rockefeller Foundation thinks so In 1909 the Rockefeller Sanitary Commission was organized for the specific purpose of fighting hookworm in the deep South The Commission made a survey of the hookworm belt and decided that about 2,000,000 Southerners had the worms Within four years they treated 500,000 cases Encouraged by their success, the Foundation extended its effects, establishing the International Health Board in 1913. The Board has fought the war against both germs and parasitic worms in over 30 countries Their achievements have led to the establishment of national and health departments all over the world. Today in Egypt, in India, in the Philippines, in Africa, even in war-torn China, the doctrine of sanitation which stamps out parasites wherever it is applied, is being taught to the people. Clean food, pure water, cleanly personal habits—all these slash the routes by which the worms gain access to the human body As the great Robert Koch once said, "It is possible for man to wipe out all infectious diseases." Universal sanitation will make Koch's prophecy a reality, for most of mankind has still to achieve a decent standard of cleanliness.

'Open House'

MEN of science of Columbia University recently staged an "Open House" session, to which the public was invited to inspect the various laboratories. Through the courtesy of *Science Observer*, official organ of The American Institute Science and Engineering Clubs, we reproduce on this page illustrations of some of the more spectacular laboratory equipment that was demonstrated

Determination of the forces necessary to shatter wooden posts (for example) gives data of value to construction engineers and others The machine shown above, capable of exerting a force of 600,000 pounds, is splintering an eight- by eight-inch fir post at a pressure of 155,000 pounds

Right Rear view of the cyclotron in the Pupin Physics Laboratory. This tool of science is used to produce beams of high-speed ions which, when they strike targets of various materials, produce effects that give physicists new insights into the problems of atomic structure and behavior With cyclotrons, transmutation of elements has been achieved, and radio-activity has been synthetized

Below With the ultra-centrifuge it is possible to subject small quantities of materials to immense stresses and to study photographically the effects. The rotor of the centrifuge is supported on, and driven by a current of air and can be revolved at such a speed that materials on its periphery are subjected to centrifugal force that equals 250,000 times the force of gravity As the rotor spins, light is directed upward through it. Since the container for the material under study is transparent, the light going through it, makes it possible to take instantaneous photographs at each revolution and thus determine effects of high rotational speed

Left In a sub-basement, mounted on bed-rock to eliminate vibration, is a small piece of equipment built with the same accuracy as is observed in the construction of fine watches It is used to test the value of lubricants in the following manner A measured coating of lubricant to be tested is transferred to the surface of a polished metal disk from an absolutely level surface of water where the lubricant has been allowed to spread into a layer one molecule thick A ball-shaped sapphire is now carefully adjusted on the oil layer that covers the metal disk and the disk is rotated. Pressure is applied to the sapphire ball until friction causes the ball to drag. When this happens, an indicator on the machine registers the fact. From the data so obtained can be calculated an index of lubricating properties of the oil

Right A torsion machine in the Civil Engineering Laboratories determines how much twisting a piece of material will take before it breaks or loses its elasticity. Bars, rods, or flat strips of any material may be subjected to torsional stress, the indicator showing the load applied

OUR POINT OF VIEW

Whose Fault is it?

IN an outstandingly notable discussion of "The Scientist in an Unscientific Society," published in our June, 1934, number, Secretary of Agriculture Wallace raised a question which since then has been the subject of a great deal of debate in scientific circles The question was "whether science, having demonstrated its power to transform the world, ought not have some responsibility, or at the very least, some interest in the social consequences of its handiwork " For example, science gives us high explosives, thinking only of the solid engineering work they will afford, and society perverts their uses to those of destruction war The scientist learns the technology of gases, others use this knowledge to maim and kill No sooner is the airplane perfected by science than others turn it into the world's nightmare

Science, according to Mr. Wallace, proceeds without moral obligation, and is neither moral nor immoral. "I should like to find our more articulate scientists," he says, "insisting that the benefactions of science be used only in ways that are plainly in the general welfare The orthodox scientist either withdraws to his cloister, to mutter about the stupidity of mankind or if given to public utterance, to indulge in an amazingly unscientific statement of a variety habitually used by the politicians he scorns " Science has been creating another world and another civilization, he adds in summary that simply must be motivated by some conspicuous social purpose, if civilization is to endure

From one of our readers, Mr Arthur Jobson, has come a letter which, though not so intended, constitutes essentially an editorial reply to these arguments We turn the column over to Mr Jobson

"Nearly six years have passed since Secretary Wallace's challenge to the scientist," he writes, "and, while this time is brief compared with the slow processes of social evolution, there has been time for the matter to ripen somewhat in our minds That his views are still held by many laymen is evident As an instance, I recall the comments of a noted newspaper writer who visited the New York World's Fair last year. This man said, in substance, that everything is there which demonstrates how man, with his capacity for precision and beauty, retains a preposterous incapacity to enjoy the fruits of his genius—to be as wise as he is intelligent, and to be as good as he is great Though he has learned to do the vector analysis in mathematical physics, he cannot add and subtract in political economy He can calculate the fineness of a machine to a millionth of an inch, but he cannot balance a government budget The general implication is that science is much to blame for this, as Secretary Wallace has stated

"Being an engineer and somewhat of a scientist myself," Mr. Jobson continues, " I am often amused at these outbursts It is of course galling to think of the great advancement we have made in science, invention and engineering while we have made so sorry a mess of our economic life, but these critics seem to forget that in matters dealing with a social system we are confronted always by the vagaries of humanity, entirely remote from the scientific approach The politician and would-be social reformer, having failed to put our economy in order, tend to clutch at a straw They reason that, since the exact mind of the scientist has attained great success in his chosen field, why shouldn't he be able to cure our social ills?

"I have a feeling that this would be impossible—this Utopia in the affairs of men. It cannot be done, for surely it would mean the most exacting kind of totalitarian state.

"No government can rise higher than its source So long as this source is contaminated by human traits, we must expect the social body to suffer The man trained in science, in endeavoring to correct this situation, would find most of his efforts of little avail, for he is vastly outnumbered by the rest of the population "

In our opinion, Mr Jobson hits the nail on the head science can plead and urge, but until man can remake his nature, the scientist's hands are practically tied He is like an individual in a big cage of baboons, who occasionally discovers choice morsels his chances of retaining control of those morsels is about on a par with the chances of the famous Celluloid dog. Nevertheless, he is essaying a start. Knowing well that he has no effectual direct way to hold off the other baboons, he has organized groups, both in this country and in Britain, for the study of indirect ways These consist essentially of education and moral persuasion Nothing stronger can be envisioned And thus all he has to do is make a clean sweep of the three human lusts for power, prestige, possession A large order!—*A. G I*

Rising Intelligence

SOMETIMES we are in despair for the intelligence of the American people. But not now For years a vociferous minority swayed the people with its propaganda for disarmament, and the people would not permit proper naval building programs The times have now demanded a change of attitude Before, it looked as though the people would never draw lessons from our past history which shows one war after another without preparedness Assurance of proper preparedness to keep us out of war is seen in the current attitude of the American public as well as in present Congressional action Even the professional pacifists have now taken up the cry for building up our defenses, even as Scientific American believed they would during all the years this magazine was urging that we prepare in times of peace

Americans are insistent that we stay out of the present war abroad Leaders agree to that dictate whole-heartedly They agree also to the principle of making our military position as impregnable as possible Hence, with a great naval building program now under way we plan a further one which would increase our Navy by about 25 percent This will mark a new high point in our naval construction which has moved upward rapidly during the last seven years after years of idleness in most of our yards

Against this background one important fact stands out That is that naval design did not suffer so much from lack of orderly evolution as most people read into the record merely because we were not actively building ships The drafting boards and the towing basin—where hulls are studied—the steam laboratories and general navy research were none of them as idle as the yards In consequence, we can build ships that are as good as any afloat Indeed, in some respects, our ships may be superior to the ships of other nations And there is little doubt that we shall learn other lessons from the present war abroad, which, added to our present naval knowledge, will carry us far toward a navy so superior in design, operation, and general efficiency, and so powerful in its aggregate fighting ability that it will tend to prevent unwanted war from descending upon us.

And that brings us back to our first paragraph. The American people want to keep out of war and at last are using their intelligence to prepare in times of peace to make sure that we do keep out—or to assure quick disaster to any who may drag us into war against our will.—*F. D M.*

New Engineering In The Navy

High-Pressure, High-Temperature Steam for Warships . . . More Reliable Machinery . . . Greater Speed . . . Economical . . . Equipment for Our New Warships

By CHARLES EDISON
Secretary of the Navy

THE new ships of various types which have joined the Fleet embody many advances and improvements in the fields of naval architecture, marine engineering, and naval ordnance. The result is increased military effectiveness. Modern warships are perhaps the most ingenious and complicated machines yet produced by man. From this fact it logically follows that any change must be well considered. But, in view of the long time required to build naval vessels, there must be a delicate balance between conservatism and adoption of advanced ideas if we are to have the maximum of military efficiency in a new ship when it comes off the building ways. This delicate balance we have striven to maintain.

An important factor in this military efficiency—where such a balance is necessary—is the machinery installation. It has been recognized for generations that we could reduce the size of our machinery and increase its efficiency if we could increase the pressure and the temperature of the steam. Such increases, however, had to await advances in metallurgy that would provide metals to withstand high-pressure, high-temperature conditions.

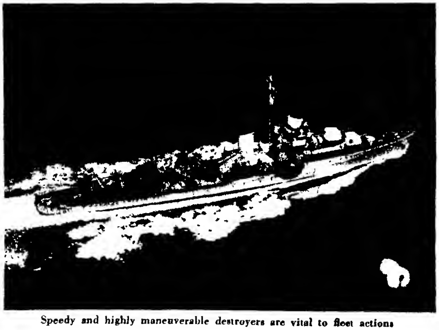
The Navy did not make the step to the present steam conditions in one leap, but has advanced in a series of conservative steps, raising pressures from 200 to 300 to 400 to 450, and then to 600 pounds, and increasing the superheat gradually. In fact, the last change was only from 600 pounds, 700 degrees, Fahrenheit, to 600 pounds, 850 degrees, Fahrenheit. These steps have lagged behind commercial practice ashore where 1200 pounds and 950 degrees, Fahrenheit, is not at all unusual for new installations, nevertheless, they have been enormously important, and a portent of others to follow.

NOW that the United States Navy is well launched upon a sensible construction program, Secretary Edison's article brings welcome news to Americans. Speed is vital to warships. If, on a given hull, more power can be installed, a greater capacity for speed results. If, moreover, the machinery is more compact and reliable than before, the result is greater military efficiency in several phases of the ship's design. The Navy is to be commended, therefore, for its persistent attack on the problem of ship power generation and propulsion which has culminated in the development of machinery that gives better speed and economy and is more reliable than older types.—*The Editor*

One of the first decisive steps taken in connection with the current building program was to serve notice to all prospective bidders that no contract would be awarded for the design or construction of naval vessels that would be out of date the day they were launched due to ultra-conservative design of main machinery and boilers. One of the by-products of this new policy has been to direct the shipbuilding industry of the country toward the development of an all-American design.

IN 1933, the Navy Department contracted for a number of destroyers. Into these ships went a distinctive American engineering installation consisting of high-speed turbines, double-reduction gears, an improved boiler feed system and a cruising turbine that is constantly in gear. The double-reduction gear permits utilization of higher turbine speeds with attendant increase in efficiency. High turbine speeds have reduced the number of turbine blades by 75 percent and the length of the rotor by 25 percent. The feed water of a modern, high-capacity, boiler installation requires the virtual elimination of oxygen in feed water. Due to the fact that the design was one of the major advances in naval engineering since the introduction of the turbine, some congestion in the engine rooms resulted. This design, however, showed an increase in fuel economy of about 25 percent with a corresponding increase in cruising radius. The first of these ships was delivered in 1936 and probably represents the greatest progress the American Navy has made in engineering in a generation.

This class of destroyers—the *Mahan* class, started in 1934—was followed in rapid succession by other modern destroyers in which were incorporated the same fundamental design features as had appeared in the *Mahan*, and in addition thereto, superheat control type boilers.



Speedy and highly maneuverable destroyers are vital to fleet actions

Photographs Official, U S Navy

Destroyers of the Fleet participating in recent maneuvers held off the California coast

In the fall of 1937, the *Somers*, one of the destroyer leaders, ran her preliminary trials with exceptional results In comparison with competitive designs she showed an improved economy ranging from 9 to 22 percent when operating at 700 degrees, Fahrenheit The *Somers* was the first vessel in the Navy to operate at 850 degrees, Fahrenheit, and when operating at that temperature increased her economy another 10 percent and increased her developed horsepower by 10,000 She was the first ship to be equipped with air-encased, separately controlled, superheat boilers

As a result of the success with the *Somers*, all battleships, cruisers, and destroyers are being built today to operate at 600 pounds and 850 degrees, Fahrenheit, and so will be all the battleships of the present building program

It is apparently no more difficult to train men to operate the new plants than it was to train them to operate the old ones On recent trials of a destroyer operating at 600 pounds, 850 degrees, Fahrenheit, one of the outstanding comments of all observers concerned the smoothness with which the crew operated that installation and controlled the temperature In fact, when it was desired to drop the temperature suddenly, on backing, it was changed from 850 degrees, Fahrenheit, to 700 degrees, Fahrenheit, in 40 seconds without difficulty

The new machinery has been of equal or greater reliability than the old type machinery This might have been expected, as old factors of safety have been maintained, or even increased, and the general design of high-speed turbines with small, comparatively short rotors, is more rugged. Service with the Fleet, of course, is fairly limited, but reports to date indicate that, as to reliability and maintenance, the new machinery is equal or superior to the old

Taking any given ship and operating its machinery under two sets of steam conditions, gives some indication of the relative merits of the two steam conditions, but that indication is not as clear cut as might he expected There are two reasons for this The high-pressure, high-temperature steam goes only to the main propulsion turbines—with the possible exception of turbo-generators in some cases The result is that at very low powers, say below 5 percent of full power, the auxiliaries take such a large proportion of the total power generated, that the effect of the high-pressure, high-temperature steam in the main turbines is masked Moreover, all turbines at very low powers—for example, below 5 percent of full power—are relatively inefficient and do not reflect much change due to steam conditions Nevertheless, at high powers, where the auxiliaries are not taking such a large proportion of total power generated, and the main turbines are able to take advantage of improved steam conditions, the improvement is shown very clearly

TWO typical examples of such tests were the ones of a cruiser and of a destroyer Trials of the cruiser were run with saturated steam and then repeated at the same pressure, but with the steam temperature raised about 200 degrees At very low powers, below 5 percent, there was no appreciable difference in over-all fuel consumption between the two conditions, but at high powers—for example, 60,000 shaft horsepower—the higher steam condition made a saving of 12.2 percent in the fuel consumption for the ship as a whole.

The destroyer was tested on two steam conditions. namely, 600 pounds pressure in both cases, but 700 degrees, Fahrenheit, temperature in one and 850 degrees, Fahrenheit, in the other Again at very low powers—below 5 percent—the over-all fuel consumption showed very little improvement, but, on operating at full power, a saving of over 14 percent was effected In fact, under the higher steam condition the ship actually developed ahout 10,000 more horsepower than designed at the lower steam condition This extra 10,000 horsepower would mean that the ship could maintain its battle speed even with very much more bottom fouling than would he possible at the lower steam condition

A better comparison of the effect of changing machinery and steam conditions is indicated when we consider what would happen if we put the complete machinery from one existing ship into another hull For example, the machinery of either of a certain two of our new destroyers could supply the power of a certain one of our cruisers which, though new, did not have such advanced machinery design The trial data of both the cruiser and the destroyers indicate clearly that if we should put destroyer type machinery in the cruiser, we could save 18 percent in cubic feet of space and 29 percent in the machinery weights, while making a gain in economy of 13 percent at full power, this gain increasing to 28 percent at a more moderate speed of 10 knots. Moreover, such data as are available indicate that the destroyer machinery is more reliable.

In short, as we have advanced steam conditions, we have developed machinery which is not only more economical, but is also more reliable and just as easy, or even easier, to operate, maintain, and protect in battle. The advances to these conditions have been by short, conservative, well tested steps, and the Navy has gained thereby.

A FAMOUS THEORY WEAKENS

The Encounter Theory of the Origin of Planets Has Now Become Shaky and May Pass into the Limbo Where the Old Nebular Hypothesis Went

By HENRY NORRIS RUSSELL, Ph.D.
Chairman of the Department of Astronomy and Director of the Observatory at Princeton University Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington

THERE are few more difficult problems than the origin of our planetary system Its isolation, and the common motion of the Sun and planets through space, practically compel us to suppose that they had a common origin. It is incredible that the many regularities within it — such as the motion of the planets in nearly circular orbits, all in the same direction and in nearly the same plane — can have been the result of accident We look for some orderly process which might have produced it — but, so far, the inventive skill of a century of astronomers has sought in vain

One encouraging hypothesis after another has been suggested, only to collapse before some simple and unanswerable objection Most of these, as many of us may remember, were dynamical, and dealt with the angular momentum — or to paraphrase Newton, the "amount of rotational motion" in the system No actions between parts of the system, once it is isolated, can alter the total amount of this — they can only transfer it from one part to another

Laplace's original hypothesis was that the system was originally a great nebula, bigger than any of the planetary orbits and much flattened at the poles by its rotation As it contracted, it rotated faster and faster, shed a ring of matter at its equator, which gathered into a planet, then later shed another, and so on till the remaining central mass shrank into the Sun

But, at present, only one part in 60 of the angular momentum is in the Sun's rotation, and the rest in the motion of the planets No one has ever been able to suggest an orderly process by which, in a system undisturbed from without, more than 98 percent of the angular momentum could get into one seventh of one percent of the mass Moreover, Jeffreys and others have proved that a ring of matter equal in mass to even a large planet like Jupiter, but extending all around its orbit, would not be gathered into a single mass by its gravitation, though it might well break up into a number of small bodies like asteroids

So this hypothesis went into limbo, and another took its place — the encounter theory. According to this, once upon a time another star, in its course through space, passed by accident very close to the Sun The original form of the hypothesis (due to Chamberlin and Moulton) assumed that the star's attraction released eruptive forces within the Sun which ejected great quantities of matter, some of which cooled into big masses and the rest into innumerable little ones — "planetesimals" — which were picked up by the bigger ones as they grew into our present planets

Later forms of the hypothesis attributed the expulsion of matter from the Sun to the tidal attraction of the star (Jeans) or to a direct collision between it and the Sun (Jeffreys) The last meets with the fewest dynamical difficulties, and gives us a picture of the two stars separating after the collision, but joined by a "filament" of matter resulting from the intermixture of the parts which actually collided A mixture composed almost wholly of solar material would be moving slowly away from the Sun and later fall back into it, similar material would accompany the star, but there would be some fairly uniformly mixed portions which would not fall back into either one Some of this stuff might escape into space — the rest would be good raw material for planets

Angular momentum again turned out to be a stumbling-block — this time angular momentum per ton of material The ultimate size of a planet's orbit depends on this Calculating it for material knocked off the Sun by a collision, it comes out too small to get a planet even as far away as the Earth. So we seemed to be back where we started. But soon afterward Lyttleton flanked the obstacle by suggesting that the Sun may once have been a double star, and that a visitor from space collided with its companion Under favorable circumstances, the intruder might send the former companion flying off into space by its attraction, without being itself retarded enough to be captured by the Sun, and yet a part of the filament of matter between them might remain within the Sun's sphere of influence and form planets

THIS gives us planets at any distance from the Sun that we want, and escapes the last difficulty. But Luyten has shown that the conditions required to let both the former companion of the Sun and the intruding star escape, and yet have planet forming material which did not get away, are extremely difficult to fulfil, and the question is still in debate

The objections which have so far been raised to the various forms of the encounter theory are purely dynamical They depend on simple consequences of the law of gravitation, and could have been discussed as intelligently in the days when Neptune was discovered as at present

But, even if all these difficulties had been fully removed, there would remain others, different in character, but quite as serious One of these is that the matter ejected from the stars, whether by tidal action or collision, must at the start have been extremely hot There is no sense in thinking of it as having about the temperature of the Sun's surface A very simple calculation shows that, if enough material to form Jupiter were spread in a uniform layer over the Sun's surface, the pressure at the bottom, due to solar gravity, would be 880,000 atmospheres, and the average pressure throughout the layer half as great At a depth where there was such a pressure, the temperature would also be very high To estimate it accurately, we would have to know how the outer parts of the Sun were built, but there is no doubt that it must be several hundred thousand degrees If this intensely hot gas were pulled out of the Sun by tidal action, it might be cooled somewhat by expansion, but if it were scraped off by a collision, the friction between the intermingling solar and stellar gases would heat the mixture to a far higher temperature.

If the filament of gas connecting the two stars remained anything like as hot as this, the velocities of the separate atoms would be much too great for the relatively weak attraction of the ejected matter to hold them back. They would fly away separately and the gas would dissipate itself into space. This has been realized for 60 years. But the

gaseous mass, radiating freely into space, would also cool very rapidly, which would slow up the atomic motions, diminish the internal pressure, and tend toward stability. In this race between expansion and radiation, which would win?

This is a problem not of dynamics, but of physics, and would have been unanswerable without the aid of modern knowledge of the laws of gas opacity.

If the ejected mass of gas were nearly transparent, so that heat could escape freely from its interior as well as from its surface, it would cool very rapidly—giving out at first a tremendous burst of remote ultra-violet light, and then settling down, perhaps to condensation. But if we consider such a layer while still in the Sun, we find that radiation can escape directly from only the thinnest kind of surface skin containing less than a millionth part of its whole mass.

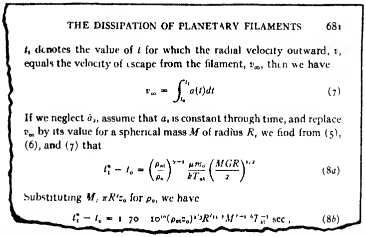
The difficult problem of the behavior of the filament after its formation was attacked for the first time by Dr. Spitzer—a National Research Fellow at Harvard—and his results, just published, afford a definite answer.

To get the problem into mathematically tractable form, he has of course to make simplifying assumptions, treating the filament as a uniform cylinder in shape, and taking average values of the pressure, and so on, in the interior. It is possible to handle these approximations so that we are sure that we are not getting too small an answer—or too large, if we proceed differently.

Working in this way, Spitzer finds that, if no heat were lost by radiation, a filament of 1/500 of the Sun's mass, and a million miles long, would expand into a state in which the separate atoms were flying off so fast that the attraction of the filament could never bring them back in less than three hours. A better approximation, taking account of the fact that the filament must be growing longer as the stars separate, reduces the time to half an hour.

To calculate the rate of cooling is more difficult, but, for the same circular filament as before, it is found that direct escape of heat takes place only from a very thin outer skin, and that, if the filament could be held at its initial size by some imagined force, it would take at least a year to get rid of half its original content of heat.

THE disparity of these two numbers is so great that there is no room for doubt that an actual filament of gas would expand so fast that it could never check itself, long before cooling produced any perceptible effect. Straining every assumption in favor of the cooling process, Spitzer finds that it must, in the most extreme case, take more than a hundred times longer than the expansion. To assume that the original filament was flat like a ribbon instead of circular in section makes the disparity even greater.


THE DISSIPATION OF PLANETARY FILAMENTS 681

t_1 denotes the value of t for which the radial velocity outward, v, equals the velocity of escape from the filament, v_∞, then we have

$$v_\infty = \int_{t_0}^{t_1} a(t)dt \qquad (7)$$

If we neglect $\dot{a}_z$, assume that a_z is constant through time, and replace v_∞ by its value for a spherical mass M of radius R, we find from (5), (6), and (7) that

$$t_1^* - t_0 = \left(\frac{\rho_{st}}{\rho_0}\right)^{\gamma-1} \frac{\mu m_0}{kT_{st}} \left(\frac{MGR}{2}\right)^{1/2} \qquad (8a)$$

Substituting $M/\pi R^2 z_0$ for ρ_0, we have

$$t_1^* - t_0 = 1.70 \times 10^{10}(\rho_{st}z_0)^{2/3}R^{1.6}M^{-1.67}T_{st}^{-1} \text{ sec}, \qquad (8b)$$

In his monthly articles on astronomy, Professor Russell interprets for the average reader many professional papers previously published for the astronomer, hence in mathematical form. Above is a sample of the article behind the present interpretation, from *The Astrophysical Journal* of last December. *The Astrophysical Journal* is the outstanding publication of its kind for American astronomy, just as the *Monthly Notices* of the Royal Astronomical Society, on which some of Professor Russell's articles are based, is for Great Britain. Most of the important astronomical papers in the English language are published in one or the other of these two journals, in fact "most" might well read "virtually all"

This analysis—the first in which modern physical methods have been applied to the problem—looks as if it would send all the forms of the encounter theory to Valhalla. There is still one unexplored consequence. The filament would fade away by expansion, but the gases of which it had been composed must go somewhere. Part of them would fall back into the stars, part, near the middle, would be left wandering as lonely atoms in "the wind that blows between the worlds"; but the rest, and probably a good deal, would settle down into a gaseous atmosphere about the Sun, and another about the retreating star. These envelopes would not be held up by pressure from below, like the Earth's atmosphere, they would be in rotation about the Sun—an immense swarm of atomic asteroids, if the phrase may be pardoned—colliding with one another every few hundred miles, bouncing off into new paths, but, as a whole, forming an enduring gaseous shell.

Whether such a non-uniformly rotating atmosphere could condense into solid bodies has not yet been investigated. If it turns out that it could, the encounter theory may yet be revived—for the requisite angular momentum is there.

It is very hard, though, to see how most of the mass could be concentrated into a single large body which, like Jupiter, is rich in hydrogen. Those atoms or molecules which absorbed sunlight strongly would be driven away at once by radiation pressure; the others, which scattered light weakly, would be subject to the effect worked out by Poynting and Robertson, and would gradually spiral into the Sun. But, for such bodies, this action would be slow and there might be time enough for a good deal to happen.

If material enough to form all the planets were distributed uniformly inside a sphere as big as Neptune's orbit, the total amount of matter along a column a square centimeter in cross-section, extending from the center to the edge, would be about a gram. It might seem at first that so thin a layer of gas could produce no perceptible effect, but it amounts to a thousandth part of the whole atmosphere of the Earth. Such a layer of gas, illuminated by ordinary sunlight, would scatter 1/1000 as much light as a clear noonday sky, or 500 times as much as a clear sky under full moonlight—and hence be extremely conspicuous against a really dark background. Sunlight at Neptune's distance is approximately 1/1000 as bright as at the Earth's, but, even under this illumination the shell of gas would appear half as bright as a moonlit sky, and hence far brighter than any ordinary nebula. The Sun, surrounded by such a gaseous envelope, and seen from Alpha Centauri, would appear at the center of a bright nebulosity, fading away gradually at the outside, and about 45 seconds in diameter. The glare of the Sun would probably obscure this on photographs, but it would be conspicuous in a reflecting telescope, with the central star hidden. If, however, the heavier atoms and molecules had coalesced into dust particles, the medium might form a fog thick enough to obscure the Sun from points outside it. But, in that case, the effects of light-pressure would appear and it would not last very long.—*Princeton, December 20, 1939.*

Debutante Metal—Beryllium

. Large Supplies . . . Makes Extremely Hard Alloys of Copper, Other Metals . . . Low Percentage is Needed . . . Research Finding New Alloys, New Uses

By PHILIP H. SMITH

USES FOR BERYLLIUM COPPER
Fuse clips
Switch blades
Vibrator arms
Contact brushes
Appliance plug clips
Plugboard contacts
Switch jaws
Circuit breaker springs
Relay springs
Brush holder springs
Electric range switch parts
Thermostatic control springs
Leaf or helical springs
Contact springs
Bourdon pressure springs
Optical alloys
Spring washers
Sylphon bellows
Diaphragms
Fountain pen clips
Camera parts
Instrument parts
Gasoline- and oil-pump parts
Cams
Valve parts
Watch parts
Gears
Precision bearings and bushings
Plastic molds
Die casting dies
Welding electrodes
Non-sparking tools

IF beryllium could boast no definite commercial accomplishments, it could still lay claim to a measure of fame What other metal remained, to the man in the street, little more than a name for a century, only to win prominence overnight by strutting the Washington stage?

It is fact that beryllium was hardly known to the general public until hearings before the Temporary National Economic Committee revealed that it was a strategic material of war, that there was jockeying among nations to acquire the secrets of its use, and that Germany led in the race So much was said at the hearings about beryllium as a metal of the future that one could hardly appraise it as a metal in present commercial use, much less figure out what is required to translate futures into actualities. Now that the coming out party fades from memory, just what is there about this debutante among metals that makes it so important?

Until the Washington hearings, beryllium was tracing a perfectly normal, if little-known, course There was its identification very long ago — 1797, to be exact Then came its chemical isolation more than a century ago Like many other elements, it remained a curiosity for decades before its value was recognized Just prior to the great inflation in Germany, the firm of Siemens Halske put a staff of men to work probing this unknown metal, in the correct belief that one of the best ways to preserve capital is to plow it into productive research That really dates the commercial beginning of beryllium, because at that time was discovered the extraordinary heat-treatable characteristics of beryllium-copper alloys — a discovery of immediate commercial value

OF course, a lot of things had to be discovered to bring beryllium out into the open Methods of recovery had to be devised, because research could not be widespread when only small amounts of the metal were available As recently as 1922, the cost was $5000 a pound As extraction problems were solved, the price fell steadily to reach today's figure of $15 As soon as increasing amounts appeared, researchers undertook to study physical characteristics

The peculiar qualities that recommend beryllium at this stage in its development are, light weight — it is lighter than aluminum; durability, fatigue resistance; and a strong affinity for oxygen and sulfur These qualities have been exploited to make beryllium valuable in a number of ways which require discussion

Beryllium plays its outstanding rôle as an alloying metal, and beryllium copper is out in front at the moment Copper, as we know, is a soft metal, but add anywhere from 1.5 to 2.75 percent of beryllium give it heat treatment, and it acquires hardness comparable with that of steel The usual admix is about 2 percent When beryllium is added in such amount, the resultant alloy shows a tensile strength of 70,000 pounds per square inch in an annealed, soft state, whereas cold-rolled and heat-treated strip will give a tensile strength of 190,000 pounds per square inch By way of contrast, structural steel has a tensile strength of 60,000 pounds.

It is the peculiarity of this alloy that it can be formed in relatively soft temper, and in the ductile state can be rolled, forged, and drawn After heat-treatment it acquires its extreme strength and hardness

Beryllium-copper has very wide use as a spring material A more uniform product can be made — because of the above-mentioned heat treatable characteristic — than is possible with spring steel and phosphor bronze, and the alloy is virtually untiring A beryllium copper spring, for example, can be flexed 15 billion times as contrasted to 400,000 for phosphor bronze In addition to imparting strength and hardness to the alloy, heat-treatment also increases the elastic limit, modulus of elasticity, electrical and thermal conductivity, and wear resistance These added properties can be controlled through proper time and heat regulation Finally, beryllium-copper is non-magnetic and will not spark when struck

IS it any wonder that this new alloy has cut a wide swath in the manufacture of springs? The number and variety of applications is, today, so broad that reference had best be made to the accompanying table But, at the same time, it would be an error to believe that simple substitution of beryllium-copper has achieved the desired result. Success has come as a result of keeping in mind the basic properties of the alloy when designing a product, as well as understanding completely the heat-treating process With this backlog of knowledge, manufacturers have been employing beryllium-copper to produce, for example, springs having smaller over-all size for use in re-designed equipment featuring space saving Such change overs continue

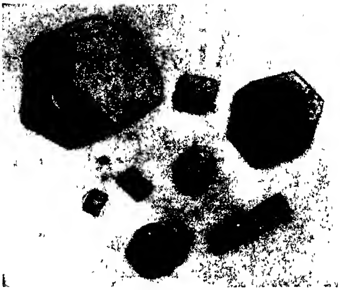
The high strength of beryllium copper, coupled with wear resistance, has recommended the alloy for bearings, bushings, and certain types of gears. Its non-sparking quality, coupled with hardness, makes it suitable for special tools to be used in plants where there are explosives or inflammables If the practical nature of such tools is questioned doubt can be dispelled by dem-

onstrating that a beryllium-copper chisel can be driven through steel. As contrasted to bronze, beryllium-copper has a five times greater wear resistance when used in conjunction with steel, and the alloy has been used quite successfully with unusually high loads where there is small relative motion.

Within the past few years there has been considerable experimentation with beryllium-copper as a material for cast molds in the plastics industry. Some of this work has been fruitful, and cast beryllium-copper molds are in use today because they approach the ideal still being sought. The particular merits of the material are three in number: a low melting point and good flowing qualities which give excellent reproduction of detail, high compressive strength upon heat-treating, and a thermal conductivity twice that of steel, which permits a quicker molding cycle.

There are many types of beryllium copper but it will be sufficient to mention one more. This is an alloy formed with 0.4 percent beryllium, 2.6 percent cobalt, and the remainder copper. Wire of this alloy has been drawn to a tensile strength of 137,000 pounds per square inch, having a conductivity 50 percent that of copper. It has been used to make electrodes for resistance welding and has proved satisfactory in spot-welding stainless steel, in seam welding wheels, and in electrode parts for projection welding.

THE amazing change wrought in copper by a touch of beryllium created an alloy with immediate practical use, but it remained for beryllium to touch nickel to set off a whole chain of verbal fireworks in Washington. The alloy, beryllium-nickel, has not been made in this country, because the method is unknown and experimenters are momentarily stopped. It has been made in Germany and the international patent situation was what brought beryllium into the Washington hearings. Testimony was presented to the effect that beryllium-nickel valve springs functioned in aircraft engines without showing the slightest fatigue and that bushings of the material never failed in German planes. It is known, further, that the alloy, heat-treated from the hard rolled material, acquires a tensile strength of



Above: One source of beryllium: beryl crystals. *Below:* Master alloy—4 percent beryllium, rest copper

Beryllium-copper tools find use near explosives because they won't spark, will easily cut cold-rolled steel, below

260,000 pounds per square inch as contrasted to 60,000 pounds for structural steel, and 90,000 for stainless steel. Here, again, 2 percent of beryllium does the trick.

This revelation — that there was a material available which would improve the performance of aircraft engines — touched off a series of questions. Is there an adequate supply of beryllium in this country? Can we make beryllium-nickel? Cannot beryllium be employed to make a strong, light alloy of aluminum or magnesium? These questions were raised in rapid succession and their answers will throw more light on this metal extraordinary.

THERE is no scarcity of beryllium. It exists plentifully in beryl and other mineral ores scattered throughout this country and the rest of the world. Its extraction in the pure state is difficult and expensive, but it can and is used readily in oxide form. Cost of extraction varies in accordance with the richness of the ores and, at the moment, most beryllium is obtained as a by-product of other mining operations. Having found how to use beryllium oxide in alloying copper, a short-circuiting of the process has led to lower costs, but problems arising in production of beryllium-nickel are not the same.

Beryllium-nickel will be made here under German license. One of the revealed difficulties is that alloying cannot be carried on with conventional methods without undue loss from oxidation, and that special equipment is required to do the trick, unless, of course, something hitherto unknown is discovered about the handling of the metals.

The union of beryllium and aluminum to make a light, strong alloy, is still more of a hope than a reality, despite all published reports of success. When beryllium is used in high percentage to contribute its advantages of lightness and rigidity, the resultant product is too brittle in the cold state to be commercially useful. Some investigators claim that aluminum can be age-hardened, while others declare that alloys of the duralumin type alone can be so benefitted, and that small amounts of beryllium added to aluminum are inert or behave in the manner of silicon. At

Photographs courtesy The Beryllium Corporation

Pouring a master alloy of beryllium and copper

the moment, there is a hint that beryllium and aluminum can be combined to create an alloy having a high tensile strength and yield point at operating temperatures of 500 to 600 degrees, Fahrenheit. If this hint is substantiated, the aircraft industry may have a new material for pistons.

Magnesium, another hope, has not yet gratified experimenters by forming an alloy with beryllium, and the problem is complicated by the difference in melting points. Whether or not some way will be found to make the ultra-strong, light-weight alloys which hope has made "fact" in the news, remains to be seen. The value of such a discovery puts it in the not impossible class of research projects. The mere suggestion that hope is not abandoned is a way of saying that probers will keep hard at work.

Among research men there is speculation as to what might be done by employing powder metallurgy to combine beryllium and aluminum or magnesium. Significant results have been obtained by mixing the powders of other metals and heat-treating to produce hard materials, so why not try it here?

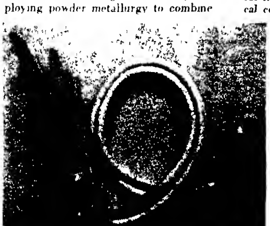
Some of the interesting successes in beryllium research are nickel-chrome-iron-beryllium and beryllium-gold. The former alloy has a possible elastic limit of 200,000 pounds per square inch, is highly corrosion-resistant and non-magnetic. Its commercial use is now limited to replacing watch spring steel in high-grade watches. Beryllium-gold, formed with 1 percent of beryllium, is extremely hard and can be used as a dental inlay and for low-melting gold solders.

Typical use of beryllium-copper, for its fatigue resistance, in electrical contacts for time-control clock

While beryllium's affinity for oxygen is a nuisance in the production of certain alloys, this affinity is an asset to industry. The metal reacts with all oxides at high temperatures and seizes upon nitrogen, sulfur, and carbon, as well. The deoxidizing and desulfurizing properties are now being used to permit production of high-conductivity copper castings and to remove the sulfur in steel melts. Even when a high sulfur content remains in steel, it is still possible to roll it if beryllium is present in small amounts. Pure nickel can be rolled without using magnesium and manganese if beryllium is added.

It should occasion no surprise if beryllium makes more rapid commercial progress from now on. Aluminum, molybdenum and the rest of the newer metals required a solid groundwork of research before they advanced far into industry. Beryllium production processes have been simplified to bring price within a range that warrants research looking to wider commercial application. The achievements of beryllium copper have been adequate to answer skeptics and resistance to adoption is now very largely overcome by the knowledge which fabricators have acquired as to its use. The metal is hardly obtainable in the pure state, but there are master alloys available with copper, nickel, and iron.

In many respects cost is still a deterrent to use but when it is recalled that other metals began their careers from a high plateau and dropped lower as use expanded, the present course of beryllium is wholly normal. If as many still hope, alloys with light metals can be produced, cost will be less of an obstacle because performance will be worth the price. Such an achievement would justify all the research work which could be brought to bear upon the problem, and would validate all the flaming headlines which have promised a revolution in metals.



Left: The thermostatic control for an automobile heater uses beryllium-copper spring contacts as shown at left end of this double cable

Right: The same alloy, in cast form, is used in many kinds of electrical apparatus. The photograph shows the metal cast as a part of a circuit breaker

Why Pure Science Pays

Time After Time Scientists Interested in Finding New Facts Purely for Their Own Sake— Intellectual Curiosity – Have Handed Fortunes to Industry

By A. CRESSY MORRISON

President of the New York Academy of Sciences

MICHAEL FARADAY'S discovery of the principle of electromagnetic induction, was, for him, the reward of an excursion into the unknown, the fruit of pure reason, an idea embodied ultimately in an experiment. To Faraday's contemporaries, his discovery meant little or nothing. To those of us who live in this electrical age, Faraday's toy has become the foundation of a new civilization. It showed the way to harness the vastly powerful forces of electricity. Light, heat, power, and all the wonders which flow from the millions of electric dynamos and motors, which lift burdens of toil from our shoulders, delight and amuse us, employ simply and directly the principles of Faraday's discovery.

Whatever may have been Faraday's gift of prophecy, it is certain that he was led to this discovery, as to others, by an insatiable desire to learn and to know. No hope of other reward was needed to goad his active imagination. No vision of immediate usefulness spurred him in the search for truth.

Quite obviously, in our fast moving age, the long gap between Faraday's discovery and its application to human needs has been materially shortened by the development of vastly intricate industrial machinery to feed upon and utilize the results of researches in pure science. Obviously, too, the wealth created by industry should supply the essential support and stimulus to research in pure science. President Conant of Harvard has described this relationship by a happy analogy drawn from the field of biology. He terms the mutual interdependence of pure science, pursued for the purpose of increasing human knowledge and industry, whose objective is the creation of wealth in the broadest sense of that word, as "symbiosis" (living together). To make this meaning clear, he illustrates symbiosis by describing the process by which lichens live. A tender green plant synthesizes food for itself and also for a strong colorless fungus whose hardiness protects both from destructive forces. The application of the figure to the present subject and its aptness in describing it are evident.

Each phase of knowledge is connected by strings, often invisible, to a previous state of knowledge. Hence, we must give considerable credit to astronomy for things that are now of everyday use. Let me give some instances of fundamental ideas essential to further development of science, which have come from astronomy. The connections are so remote as to have become practically lost.

A MATHEMATICAL equation devised by Clark Maxwell has given us radio and television. The velocity of light was first discovered by Roemer from observations of the eclipses of Jupiter's satellites, and the notion of velocity of light or radiation was essential to the formulation of Maxwell's laws. A second instance of a very remote connection is Newton's law of gravitation and the principles of mechanics which were arrived at on the basis of the motion of the Moon. It is these principles that are the base of the entire complex of mechanical things that we possess at the present time.

Astronomy made necessary the study of optics. It has developed the strength of the human eye until it has become a 200-inch reflector. Optics has, in the other direction, aided in the development of the microscope, until all the beneficent results of microscopic investigation are now in our possession and the end is not yet. The development of the study of optics and the correction of the imperfections of the human eye has given us the universal use of ordinary eyeglasses which have become one of the great factors in safety in human enjoyment, and the advancement of education.

We are indebted to astronomy for the spectroscope, which discloses with marvelous accuracy the constituents of mixed elements to be found throughout the universe, but few realize that this same instrument is now in practical use in hundreds of industries, and is disclosing immeasurably small amounts of impurities which may be useful or harmful in substances heretofore considered as pure. The majority of astronomers, if asked "What is the use of astronomy?" would probably quote Poincare, "*L'astronomie est utile parce qu'elle est belle*" (astronomy is useful because it

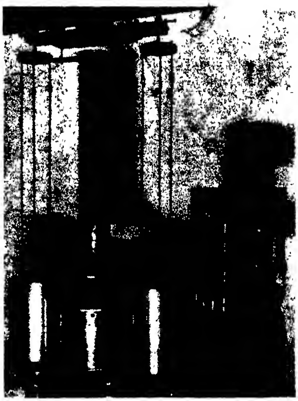
Research in pure science at the General Electric Company. Hard-headed industrial men have learned that research in pure science often pays fat dividends. Experience abundantly proves that, if research men are permitted to broaden the scope of their probings, unexpected insights and by-product facts turn up and can be converted into wealth exceeding by far the original research costs

is beautiful). If we study the work of Copernicus and the impact of Galileo's pronouncement that the Earth is not the center of the universe upon the ideology of the world, we find that it has changed and is changing the philosophy of every human being.

Daguerre discovered photography—step by step it has advanced. As early as 1869 the process which awaited only the development of the film and the proper chemicals to produce pictures in color was announced. The moving-picture industry rests upon his discovery, and its effect upon the world is already apparent. Who would have supposed that Daguerre's discovery, as now developed, would so improve the accuracy and facilities of astronomy that nebulae have now become island universes, space has grown from thousands to millions of light-years, new radiations have been recorded, and photography has become the handmaiden of astronomy?

PERHAPS no single scientific discovery has had today such enormous and so valuable use as catalysis, invaluable tool of chemistry. Indeed, there are few processes of chemical industry which do not employ such a promoter of one kind or another to accelerate and direct chemical reactions toward desired ends. Even the simple, universal reaction of combustion requires the presence of a minute amount of water vapor to allow it to proceed.

The ancients visioned the invaluable usefulness of the promoters of chemical reactions which we now designate as catalysts and sought a universally active substance of the kind under the name of the "philosopher's stone." The advent of chemistry as a science directed attention toward these traces of extraneous substances necessary to bring about certain chemical reactions, and, more than a century ago, Berzelius had accumulated enough information on the subject to give phenomena of this type the name catalysis. Berzelius and a host of other investigators in the decades that followed pursued these inquiries without expectation of reward, but no intellectual pursuit has had more significant consequences. Sulfuric acid, as universally valuable in chemical manufacture as pig iron is in mechanical industry, is produced in our own country by the millions of tons annually by processes utilizing platinum, vanadium oxide, and other materials as catalysts. Enormous tonnages of cottonseed no longer are wasted to clog streams and foul landscapes, since a catalytic process easily converts their oil content into a palatable, nourishing solid fat. The first World War was begun only after Germany was assured independence of imported nitrate for explosive manufacture by the perfection of Haber's catalytic process for making the air supply this military essential. Though a military essential, how much more important is the fact of an unlimited supply of nitrogen to fertilize our cultivated fields and ultimately save the world from starvation. Our now commonplace, but still amazing, conquest by air of immense distances over continents and seas depends upon catalytically prepared fuels and catalytically controlled burning of them in internal combustion engines. What is true of air-born commerce is quite as true of highway traffic in vehicles powered by similar fuels.



Apparatus used by Dr. Paul R. Heyl at the National Bureau of Standards, for "weighing the Earth," or determining the constant of gravitation. But why spend public funds for weighing the Earth? One of many practical problems to which this research is related is locating oil with similar apparatus

A classical case in organic chemistry serves to illustrate the development of a chance discovery by an actively inquiring intellect into a fundamental fact of incalculable theoretical and practical importance. This is "substitution" or the replacement in an organic compound, of an atom, usually hydrogen, by an atom of another element or by a radical (a group of atoms of two or more elements). Substitution was discovered by Dumas, when he was asked to find out why the candles at a ball in Paris gave off suffocating fumes when they were burning. Dumas learned that the wax had been bleached with chlorine, and he found that chlorine had evidently replaced some of the hydrogen of the wax, yet had not destroyed its essential nature. His published paper on what he had found is one of the classics of chemistry, but the idea in it was so new that it was met with jeers. It inspired the publication, in Liebig's *Annalen*, of an ironical paper written by Wohler, but signed "S. C. H. Windler" (swindler).

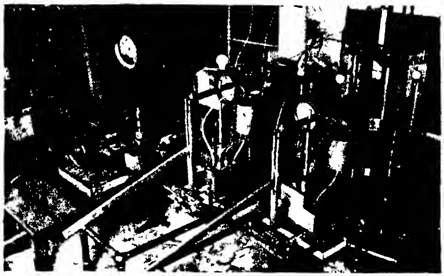
In spite of the early disbelief and ridicule, the fact of substitution was soon well established and its application has influenced the greater part of the development of organic chemistry, in the factory as well as in the laboratory. Without substitution, the chemist could never have produced the synthetic dyes, or the hundreds of invaluable medicines. It is commonly said that the dyes are obtained from coal tar. The truth of this misleading statement is that a few essential compounds obtained from coal tar are the raw materials from which are built up, step by step, with the aid of substitution, the complicated molecules which meet hundreds of human needs. The enormous development of synthetic organic chemistry is an outgrowth of a simple but fundamental discovery.

THE photo-electric effect was discovered by Hertz and Hallwachs in 1887 and 1888, respectively, more or less through difficulties with experiments carried out for other purposes. The photo-electric effect underlies the sound effects accompanying pictures and is absolutely essential for television.

"Marconi was inevitable," according to Abraham Flexner. "The credit for what has been done in the field of wireless belongs, as far as such fundamental credit can be definitely assigned to anyone, to Professor Clark Maxwell, who in 1865 carried out certain abstruse and remote calculations in the field of magnetism and electricity. Maxwell reproduced his abstract equations in a treatise published in 1873. Other discoveries supplemented Maxwell's theoretical work during the next 15 years. Finally, in 1887 and 1888, the scientific problem still remaining — that is, the detection and demonstration of the electromagnetic waves which are the carriers of wireless signals — was solved by Heinrich Hertz, a worker in Helmholtz's laboratory in Berlin. Neither Maxwell nor Hertz had any concern about the utility of their work. They had no practical objective. The inventor in the legal sense

was, of course, Marconi. But what did Marconi invent? Merely the last technical detail, the now obsolete receiving device called a 'coherer,' almost universally discarded" Yet no man will deny him the vast credit due him for making pure science in this field of supreme importance to the world

We may smile at the entomologists who measure the proboscises of butterflies and bees, but the practical application of their studies becomes immediately apparent, as is well-known in connection with that very useful plant, red clover It seems that Australia set out to grow clover, imported the seeds, and had successful crops for a year or two and then the crops failed It was then that the entomologists came to the rescue and imported bumble bees, the only insect that can fertilize red clover and now clover grows



Apparatus for placing matter under pressures of half a million pounds per square inch This is research in pure science; the experimenters were not aiming at any particular financial gain but were activated by intellectual curiosity Yet almost certainly industry will find applications for the new knowledge gained

THE utility of geology as a means to the discovery of metals, minerals, oils, and to the location and physical characteristics of materials for dams and other structures, is so apparent that we cannot walk a paved street anywhere in the world without its geological relationship echoing with every footstep The search for the remains of prehistoric animals has led to discoveries of prime importance in all directions But civilization, while based on material things, is equally dependent upon the increase of human knowledge The greater our understanding of the structure of the earth and the history of living creatures through an almost infinite past, with their ultimate relationship to man, the more the mind of every thinking person broadens, and better judgment develops into tolerance and understanding These contributions may do more to the elevation of the mind of man, the real objective of human life, than can be gained from developments which add merely to man's security and comfort.

Early attempts to measure the constant of gravitation, using the torsion balance, provided experience which has made possible one and perhaps the most important form of geophysical prospecting now used to find oil

Dalton's atomic theory and Mendeleeff's periodic law developed the idea that all matter was composed of a limited number of kinds of indivisible building bricks, known to us as the atoms of the elements, out of which all things are constructed. While these concepts were indispensable as stepping stones to a better understanding of the structure of matter, they seemed to close the door to the possibility of anything outside of the material.

The discovery of radium smashed these bricks and transformed them into little constellations, with a central nucleus about which revolved electrons at infinitesimal but relatively great, distances from the nucleus. This opened the door to a better understanding of forces, probably enormously more important to the ultimate destiny of man than the material benefits which have already so magnificently followed the discovery of radio activity in all its present applications

Few know that the study of the locomotion of fishes has added to the speed of airplanes

Gibbs' phase-rule, as is well known obtained in Gibbs' profound studies of chemical and physical equilibrium, is the guiding idea that has made possible a great part of our development of alloys and certainly had much to do with modern metallurgy The real greatness of Josiah Willard Gibbs is slowly but surely becoming realized and as an American scientist he now takes his place as one of the first mathematical physicists of all time

The Joule-Thompson effect deals with the change of temperature when a gas expands from a high pressure to a lower one It is the basis of the process of liquefaction of gases, and of the air conditioning and refrigeration industries we have at present I doubt whether any reader of the original scientific papers describing this discovery could have had any idea of the tremendous potentialities of the simple "porous plug" experiments as originally carried out

In 1917, helium was a chemical curiosity that had been produced only in small quantities by investigators in pure science Its discovery on Earth had followed the finding of it in the Sun Where it could be bought at all, it cost about $2000 per cubic foot However technical men saw the possibility of extracting helium from natural gas for use in lighter-than air craft and suggested it for military aeronautics An efficient extraction process was developed, by which helium could be secured in quantity at low cost Helium is now produced at approximately one cent per cubic foot, and in quantities suitable for man's uses

IN addition to the use of helium as a non explosive lifting gas for airships, it is valuable for deep-sea diving and for medical purposes Mixtures of helium and oxygen prevent caisson disease Within the past year, new diving records have been made using helium The medical profession now prescribes helium mixed with 20 percent oxygen as a breathing atmosphere for persons afflicted with asthma, and this gives almost immediate relief This humanitarian use of a once rare gas offers wide possibilities of medical application, according to reports by doctors who are studying the effects of helium on respiratory diseases

On the fine work of separating helium from natural gas rests our greatest chemical industry By the use of waste gases from petroleum and natural gases, the use of coal and lime and ultimately, oil shale, we now or will produce an unnumbered variety of valuable chemicals plastics textiles like silk and wool, and possibly food and drink

These examples, drawn from many fields of purely scientific inquiry, show in unmistakable terms the enormous value of giving the searching imagination free reign Even the calculations of astronomers, accustomed to huge figures could not evaluate the wealth of comfort, convenience, health, and happiness that stem from the researches I have mentioned To forecast their effects on future generations is beyond human powers, great as these have been shown to be in other directions.

SOUNDLESS SOUND WAVES

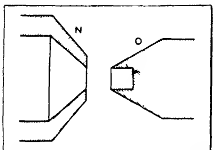
The Odd Realm of Supersonics—Inaudible, Versatile Vibrations—is Receiving Increasing Attention From Scientists . . . Paradoxical Behavior

By WALTER L. FINLAY, Ch.E.
Research Chemical Engineer Remington Arms Company

(In Two Parts—Part One)

A PALM tree crashing to the ground on an uninhabited atoll makes not even the slightest break in the utter silence. This statement is correct, of course, only in the sense that no ear perceived the fall. So far as the adjacent air molecules were concerned, however, *sound waves* were *generated* because the crash set them into longitudinal vibration.

Yet even the presence of an auditor does not always insure that a sound will be heard. This follows from the fact that the eardrum of the average human being responds only to sound vibrations ranging from a floor of about 20 to a ceiling of perhaps 20,000 cycles per second. What goes on in this 20 to 20 000 range



Redrawn from *The Jour. Scientific Instruments*

Figure 1: The simple principle of the Hartmann ultrasonic generator

is, needless to say, of daily vital concern to everyone. Indeed, its omnipresence seems, on occasion, to be almost too much with us. What transpires in the basement below 20 and, more especially, in the upper stories above 20 000 is more inobtrusive but it constitutes one of the more interesting displays in the Curiosity Shop of physical chemistry.

The region of the subaudible, that is of sound waves with frequencies below 20 cycles, is of but little practical importance. The amusing story is told how by their use R. W. Wood, Research Professor of Physics at the Johns Hopkins University once—and only once—panicked a theater audience. The author of the play planned a blackout punctuated by a shrill, drawn-out scream, to represent the turning back of 145 years. In rehearsal, however the transition proved none too convincing. Wood therefore lugged a 40-foot organ pipe backstage and, timed with the scream, poured a flood of powerful but inaudible sound waves over the darkened orchestra. An eerie chill of unreasoning fear swept over the audience and when the blackout faded 145 years earlier the lights revealed that the audience had precipitously declined to make the transition and were safe in the 20th Century, outside the theater. Later, a shaken spectator observed that he had experienced much the same sensation just before the San Francisco earthquake.

Above the audible range is the region of the ultrasonics (ultra—beyond, sonics—sound). These soundless sound waves have recently become the focus for a flattering share of scientific attention.[1] The spotlight is well merited. The investigator is lured on not only by the potential importance of ultrasonics—both theoretically and practically—but also by their paradoxical behavior. The latter is particularly intriguing, for ultrasonic vibration is, among other things: A producer of dispersions of solids in liquids but a destroyer of dispersions of solids in gases, in liquids, a disperser of solids but a coagulator of gases, in electrolysis, a promoter of desirable but a suppressor of undesirable gas evolution, with pathogenic bacteria, in some cases an augmentor and in others a diminisher of virulence, and, when applied to a human limb, a heater of the marrow but a non-heater of the bone.[1]

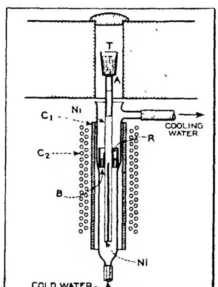
THESE are versatile vibrations indeed. Frequencies from 20,000 up to 500 000,000 cycles per second have been experimented with. In the higher ranges these vibrations take place so rapidly that the remark has been made that these vibrations are "*all* acceleration and *no* motion."

No very efficient producer of ultrasonic vibrations has as yet been developed. At present the three most popular ultrasonic generators are the Hartmann air jet, the piezoelectric oscillator, and the magnetostrictive vibrator.

The Hartmann generator (Figure 1) functions by directing a jet of air with a velocity higher than that of sound from a nozzle, *N*, into a special cup-shaped receiver, *O*. The frequency of the ultrasonics produced is a function of the dimensions. Professor Hartmann reports the relatively high efficiency of 4 percent for his device.

Piezo means "to press." A piezoelectric crystal is one which when pressed, develops a voltage between the faces pressed. Since the value of the voltage is proportional to the pressure, the piezoelectric crystal affords a very neat and accurate means for the measurement of pressures. What is even more interesting and more to the point of this discussion is the fact that the piezoelectric effect is reversible, that is if an alternating voltage is applied to the faces of a properly cut piezoelectric crystal, the crystal will alternately expand and contract in phase with the applied voltage, thereby producing sound waves.

The most commonly used piezoelectric crystal is quartz but there are many others. The feature which all these crystals have in common *is* the fact that they lack a center of symmetry. At the expense of some oversimplification one can consider an ionic crystal to be made up of an array (three dimensional network) of positive ions interpenetrating an array of negative ions. In the uncompressed



After Schmidt and Ehret in *Zeit für Elektrochem*

Figure 2: Apparatus for making ultrasonic waves magnetostrictively

[1] Over 500 single publications in the last decade and the recent publication of a textbook ("Ultrasonics" by L. Bergmann, 1938) also "Supersonics," lectures by R. W. Wood, 1939

Figure 4 Fine grain Vibrated
All photomicrographs courtesy Dr G Schmid and *Zeit für Elektrochem*
Left *Figure 3* Coarse, unvibrated

Figure 5 An unvibrated specimen

Figure 6 Same specimen, vibrated

The top pair of photomicrographs displays the contrast between the grain sizes obtained without and with ultrasonic vibration during the solidification of otherwise identical melts The refined grain structure offers considerably enhanced mechanical properties The next pair contrast a similar effect on an alloy with a brittle grain boundary The latter is completely broken up. That at right shows a dispersion of lead in aluminum, with ultrasonic vibration maintained during freezing the dispersion is maintained

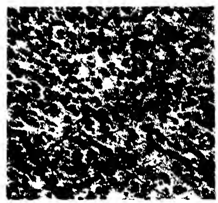


Figure 7 A vibrated dispersion

crystal the ionic charges cancel out completely throughout the crystal. Hence the crystal as a whole is neutral But if a crystal, which is not symmetrical about its center, is compressed, the spatial relationship resulting in overall neutrality is not maintained, the ionic charges no longer cancel each other out completely and net charges appear on opposite faces In the reversed case, when one face is positively and the other negatively charged, the crystal expands or contracts depending upon the polarity of the impressed voltage

Equally useful and interesting is the magnetostriction effect- the third method If a rod of ferromagnetic material is placed in a magnetic field parallel to its length, the latter is changed slightly — *perhaps one part in a million* —and a reversal of the field will reverse this change Like the piezoelectric effect, this phenomenon is reversible Compressing a nickel rod, for example will increase its magnetization And, if a coil is placed around the rod the compression will induce an E M F in the coil

AN experimental magnetostrictive oscillator devised by Schmid and Ehret is shown in Figure 2 A water cooled nickel rod, *Ni*, about 10 inches long, is used as the vibration generator It is magnetized by the direct current coil C_1 and excited into magnetostrictive vibration by a high-frequency current in the water-cooled, copper-tubing coil *C*. The Bakelite collar, *B*, supports the rubber ring *R* A crucible, *T*, is brazed to the nickel rod at *A* Schmid and Ehret were investigating the effect of ultrasonics on metals, hence the crucible, in this particular example, is surrounded by a furnace

When this crucible was filled with water and ultrasonically vibrated, the water was transformed into a very fine mist in less than one minute Any liquid of low viscosity is similarly atomized Professor Boys has pointed out an interesting analogy to this in the explosion of a depth charge The first intimation to the observer at the surface that the charge has exploded is the sudden development of a fine spray some 10 to 15 feet high Directly thereafter the familiar geyser, propelled by the explosion gases, lifts its tons of water gracefully from the sea and obliterates the mist This mist is never noted after the explosion of a mine because the relatively large volume of air in the latter acts as a cushion between the impact of the exploding gases and the water

Several interesting results were obtained when metallic melts were subjected to ultrasonic vibration in the magnetostrictive oscillator. Figures 3 and 4, for example, illustrate the grain refinement which can be obtained. The metal employed happened to be cadmium. When a metal freezes, solidification starts from a number of nuclei, or "seeds" and with further abstraction of heat these nuclei grow until the entire melt is solid In Figure 3, which solidified without vibration, heat was removed from the top and the bottom of the crucible Hence the nuclei formed at both the top and the bottom and grew into the center of the melt Thus the interlocking, columnar-shaped crystals were formed But, when the melt was ultrasonically vibrated, the nuclei were broken up and scattered throughout the molten metal and the fine-grained structure of Figure 4 was obtained

By a similar mechanism, segregation is counteracted, and brittle grain boundaries can also be broken up Thus Figure 6 illustrates the effect of ultrasonics on the continuous grain boundary material of the unvibrated specimen in Figure 5

Lead and aluminum are no more miscible in the liquid state than are oil and water and their difference in densities is much greater Nevertheless, even here the industrious ultrasonics can bring about a fair degree of emulsification. Figure 7 shows a dispersion of lead in aluminum This dispersion is not very stable but if the ultrasonic radiation is continued until freezing is complete the dispersion is, of course, maintained

The potential commercial applications of ultrasonics are interesting A whole new industry, popularly known as powder metallurgy, has come into being in the past few years to fill certain definite needs which conventional metallurgical methods could not satisfy, for example, to make "forced alloys" for bearings of metals which are immiscible in the liquid and solid states Perhaps the emulsifying power of ultrasonic vibrations offers an alternative process for effecting certain metal combinations otherwise unobtainable.

(To be concluded)

Restoring Rome's Colosseum

Recent Excavations Beneath the Ancient Arena Reveal Elevator Shafts for Raising Wild Beasts to the Combat Level by Means of Counterweights

By H. T. RUTLEDGE

HOW the lions, tigers, and other savage beasts were handled and liberated simultaneously into the arena of the great Roman Colosseum with a dispatch that would do credit to Frank Buck, Clyde Beatty, or any other famous animal director, has been revealed by the excavations of Prof. Guiseppe Cozzo, an Italian authority on that historical structure. For centuries, until recently, the lower half of the Colosseum has been buried and none of its lower parts has been visible.

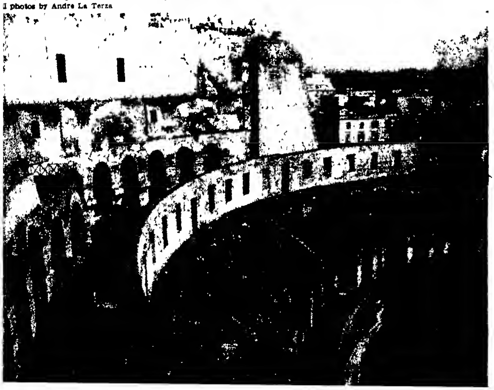
After several months of excavations into the long-hidden depths of the Colosseum, Professor Cozzo has uncovered the *hypogeum* or "back" stage, 20 feet below the level of the arena, where the stage was set for gladiatorial combats with wild beasts, also where the stage settings and the cages for the beasts were kept.

The ancient *hypogeum* contained not only the cages of the wild beasts but 32 cells for lifting them simultaneously to the level of the arena. The animals whipped by the keepers who followed them, were forced to pass from their cages to and along a passageway less than three feet in width to the elevator cells. In this narrow space they were unable to turn around to attack. The cages in which beasts were lifted are indicated by the discovered evidence to have been 38 inches wide, five and a half feet long, and almost six feet in height. This was large enough to permit holding the largest lions in these cages for several hours at a time, in order to have them ready when they were wanted in the arena. The cages themselves no longer exist but their dimensions have been approximated from the size of the elevator shafts. Similar cages probably will be constructed. The elevators were operated with counterbalancing weights — not alone by winches and pulleys as most authorities on the Colosseum had previously supposed. At a signal by the stage manager, the 32 keepers released the respective counterweights and the 32 cages rose simultaneously. The cages had no doors but, until they were lifted, they were shut off by iron gates immediately in front of them.

Workmen with dump cars of earth and debris to be removed from beneath the arena

Partly ruined tiers that once supported the seats in the Colosseum. Seating capacity was about 50,000, though this is often exaggerated — was done so, in fact, by the Romans themselves

All photos by Andre La Terza



As soon as the wild beasts reached the level of the arena, about 20 feet above, and found a free outlet they made their way, attracted by the light, through separated corridors and all appeared in the open at the same time.

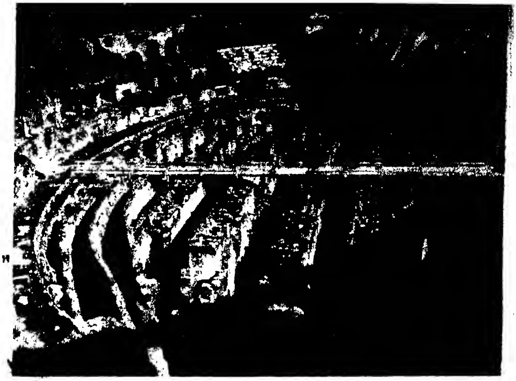
As the arena was an oval 281 feet in length and 177 feet in width, the combat sometimes lasted a long time, since the battle probably was not immediately provoked, as it would have been in a small space. Indeed, the arena was so large that the contest with the beasts was called *venatio* — a hunt — and the men who hunted were called *bestiarii*.

Eighteen hundred years ago a band of gladiators in the arena held their spears at an angle against the sand floor as they nervously awaited the entrance of the lions. At a preconcerted signal, the famished lions appeared from the sides of the arena, stalked the gladiators, and the battle with the beasts followed. Thrilled by this terrible spectacle which came to cap a program of cruelty, more than 50,000 spectators, often including the Emperor and always many of the nobility of Rome, looked down

from the several tiers of the great Colosseum.

Although there were many amphitheaters in Roman territory, including the one so graphically described in Bulwer Lytton's "Last Days of Pompeii," none of the others had the elaborate equipment for such cruel mass performances as were held in the great Colosseum at Rome. In the hundred days of games held upon the opening of the Colosseum, 5000 lions, tigers, and other wild beasts and 3000 gladiators were slaughtered.

As the Colosseum was unique in many respects it is important to reconstruct the giant edifice as near like the original as possible. However, restoration will not involve completely rebuilding the structure as it originally stood, but will mean the reconstruction of all those parts that remain. Thus the floor of the arena will be reconstructed, not of pine boards as it was in the Romans' day, but of substantial concrete — though a part of the flooring may be of boards, in order to give the public an exact idea of the maneuvers employed in setting the stage for gladiatorial combats or for great pageants and sporting events. It has also been suggested that sports be revived in this famous amphitheater.



How the central part of the Colosseum appears today after the current excavations, showing the complex structural details beneath the arena, which was carried on bridging planks

Laborers trundling a dump car along a light track 20-odd feet below the level of the ancient arena. Through these same passageways howled the lions of old Rome

Now that the plan for reconstruction is under way, it will be of interest to recall some of the more outstanding facts about the Colosseum. Even today it is a gigantic and impressive structure and not at all lacking in majesty because of its modern surroundings. It was begun by the Emperor Vespasian, who brought with him on his return from Judea 12,000 Jewish prisoners to do the rough labor. It is 159 feet in height, and in plan is elliptical with the major axis 615 feet, the minor axis 510 feet. It is composed of huge blocks of travertine rock, though the interior is of marble and brick. It is still possible to see, near the top, the holes to which were attached the canopies which completely covered the great structure to keep off the hot sun.

The arena was surrounded by a wall 12 feet high to protect the onlookers from maddened beasts or men. This wall now is largely ruined. The basement part which Professor Cozzo has been excavating is made of long, thin bricks (Roman bricks).

In the Colosseum the seats nearest the arena were reserved for the state officials, and above these were those for the nobles and the rich. Higher still were those for the populace. Exits (*vomitoria*) were efficiently designed to facilitate departure of the crowds, the Romans were just as aware of such matters as we are today, and perhaps a little more so than some of our earlier designers of large auditoria. The Colosseum seats were numbered and the "tickets"—inscribed clay pieces—have been found.

The first Christian martyrs to be thrown to the wild beasts died in the arena of the Colosseum and, because of these martyrs, who succeeded the gladiators, the Colosseum was venerated greatly during the Middle Ages. It was considered to be a monument consecrated to the martyrdom of the early Christians. Only for that reason was it saved and for the same reason the vast structure, partially in ruins but still impressive in character, is still revered by many in the civilized world.

FOR hundreds of years, through which degeneracy and sensuality and ill-won opulence helped bring about the corruption of once great Rome, the brutal combats persisted in the Colosseum. Only when Telemachus, a white-clad monk, on January first, 404 A.D., placed himself among the blood-stained gladiators and called a halt in the name of God to the shedding of blood, did the gladiatorial combats cease. Telemachus was stoned to death, but Honorarius, the Consul, issued an edict forbidding such combats.

Glass Takes On Color

New Fields Opened for Plate Glass . . . Decorative Mirrors . . . Sand-Blasted Designs . . . Panels Lighted at Edges . . . Careful Experimentation

By EARL AIKEN

NO longer is a mirror merely something to use for shaving or to check the tilt of m'lady's millinery. The hand of research has lifted us out of the old-fashioned Looking Glass era Colored plate glass, for example, has stimulated new thought, opened the door to a mental gold mine of interpretive thinking in applying new types of flat glass to serve us better in utilitarian and decorative uses in every-day life

One of the interesting trends among architects designers and interior decorators now becoming increasingly popular is the practice of facing an entire wall area with plate-glass mirrors Thus, in rooms of restricted size, is given a sense of spaciousness by apparently doubling the size of the room and repeating furniture and fixture patterns by reflection This idea received added impetus when plate glass became more and more available in larger sizes, and it was accelerated particularly with the recent advent of colored plate glass

The most extensive use of modern flat glass of any installation that has yet been made in this country is in a Chicago restaurant One whole wall was faced in colorful opaque structural flat glass, with colored inlay worked into a series of scenes depicting the harvesting of food products throughout the world, sand-blasted designs in clear plate, the panels edge lighted by indirect illumination to make the characters seem to float in space, and a whole wall in mirrors against which was built a stairway and semi-circular ceiling lighting fixtures The restaurant seems double its actual size and the vast reflecting areas repeat design and colors in such a way that the surroundings strike a new high in practical fairylandia

From the business man's standpoint this movement is thought-provoking The Chicago restaurant just mentioned is not an exclusive rendezvous but a cafeteria where office workers are in the majority Since modernization, the restaurant's business has tripled

This new interpretation of what can be done with plate glass in the form of mirrors has lifted many prosaic commercial establishments to a new plane of utilitarian beauty. But the small gown shop, the little cocktail lounge, the drug store, and all the stores along Main Street Everywhere have no corner on the modern Magic with Mirrors, the modern home, from the colonial Cape Cods to the modern streamlined dwellings, reflect the fact that you can see far more than yourself if you'll look at a mirror properly

Illustrations courtesy Libbey-Owens-Ford

Mirrored plate-glass paneling, placed at one end of a living room, reflects the dining room beyond, making the living room seem larger than it is in actuality

SCIENTIFIC development of a product often is visualized by the layman as a drably mysterious evolution among test tubes, bi-focal delving into volumes of chemistry data by scholarly gentlemen who talk in riddles and move in an atmosphere of pre-occupied self-sufficiency Quite the contrary, of course, modern scientific developments sparkle with interest Consider, for example, the development of plate glass. Its historic past and romantic present are rivaled only by its fascinating future

In order to get a better appreciation of it, however, it is necessary to understand, first of all, the difference between plate glass and sheet or window glass Most people, when asked for the answer, usually say "Well, plate glass is thicker," and add an explanatory note that it's "heavier" and "larger"

That isn't the answer, of course In chemical content and physical size, window glass and plate glass may be identical; the difference between them is that plate glass must have further processing to produce the characteristics which make it superior. When window glass leaves the lehr or annealing oven, it is a finished article, requiring only wash-

ing, cutting, and inspection before being boxed for shipment. But when a plate glass "blank" leaves the lehr it is still a semi-finished raw material requiring for completion even more work than has already gone into it Its surfaces must be ground and polished to relatively close standards before it becomes plate glass ready for use as such These processes, developed and improved over a long period of years, require both extreme care and large machinery investment.

On broad conveyors wider than flat cars and, like flat cars, moving on rails and in trains, the blanks, continuously bathed in water and sand which varies from coarse to fine, are carried under rotating grinders where the corrugated surfaces are ground away to parallel planes, thus eliminating distortion by taking off waves and surface irregularities Then the conveyors carry the glass onward without interruption under the polishing machines, where, with fine iron oxide—rouge—as an abrasive, the glass is polished to high luster by felt-faced disks rotating at high speed

The surface, therefore, rather than content or thickness distinguishes plate glass from window glass The grinding and polishing of plate glass give superior clarity, gleaming beauty, and uniformity of surface long recognized as a valuable factor in the manufacture of mirrors in the display of goods in show windows and show cases

It is done with mirrors The mezzanine rail is built against the mirrored wall, adding a to[illegible] of spaciousness and luxury to the surroundings that would be difficult to obtain in any other [illegible]

THOSE applications, however, have been broadened into a vast field of amazing scope during the past five years, but to evaluate this development more completely it is helpful to look back briefly into the history of plate glass, an absorbing chapter in America's industrial history

Although glass is one of man's oldest known materials, the invention of plate glass occurred in France in the 17th Century The idea was conceived by Abraham Thevart and Lucas de Nehou, who contrived to pour glass while in fusion upon a table and to flatten it with a roller. Their goal was to produce larger and thicker sheets than was possible with the hand-blowing methods of that time Apparently they had not conceived plate glass as a highly polished glass of great clarity as we know it today, their interest seemed to be confined to getting larger and thicker panes (Window glass at this time was first hand-blown into cylinders of restricted size, then cut on one side and reheated so the cylinder would slowly flatten out Large panes of window glass as produced today were impossible to make.) The first plate-glass plant began operations near Paris in 1668, and was soon duplicated in other countries, but the industry did not attain any commercial importance until the 19th Century

For 100 years after Nehou and Thevart poured their first crude plate glass the product languished, its market being mainly for small mirrors High production costs, difficulties of transportation and the many imperfections in the glass itself precluded its use during this period as a window glazing material

In the 19th Century, improvements in furnaces and the substitution of coal, and later of gas, for wood as a fuel gradually stimulated manufacturing improvements until France and Belgium were making a vastly improved plate glass -yet very inferior in quality and volume production compared to the present

It is interesting to digress here momentarily before high-lighting the American development of plate glass The first attempt to make plate glass in America was in 1860, at Lenox, Massachusetts but for many years it was such an inferior product that practically all of the plate glass used in this country was imported

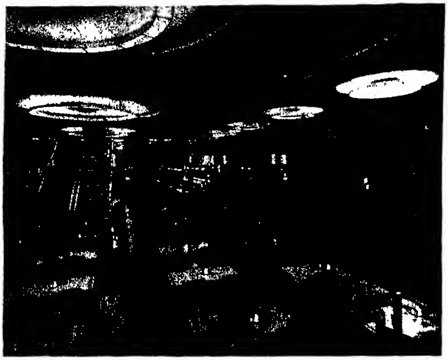
A representative of European glass interests boasted of this fact Apparently unaware of rapid developments in the United States, he finally became the target for a Philadelphia glass jobber Secretly marking three lights of plate glass the Quaker City merchant asked the agent to select the best of the three plates, explaining that at least one was of European manufacture. Much to the representative's chagrin he selected a plate glass that had just arrived from a glass plant in Missouri.

Into the American glass picture, right after the Civil War, there strode a man who came to be known as the father of the plate-glass industry in this country He was Captain John B Ford, son of Johnathan Ford, pioneer Kentuckian who had left Danville in 1814 to join the Kentucky troops who journeyed down the Ohio and Mississippi to meet the British in the closing days of the War of 1812 John Ford, the son, had been born a year before and grew up to become a successful iron manufacturer and Mississippi River fleet operator before turning his eyes to the possibilities of plate glass Eight years after the first American attempt to make plate glass had failed in America Captain Ford became interested and, in 1870, began operation of this country's first commercially successful plate-glass plant—in New Albany, Indiana

THERE followed 10 years of rapid expansion climaxed by a financial collapse Captain Ford had built several plate glass factories, but a combination of circumstances found him, in 1880, a man nearly 70 years old and the fruits of his long years of labor completely swept away What he did to overcome this situation at his age, when most men have retired, is not only an epic of American hardihood, but an integral part of this country's plate-glass history

He had lost everything but an amazing energy and capacity for work He boarded a train for New York City, hopeful of recouping some of his financial losses for a new start by selling a patent on sewer pipe made of rough glass to Peter Cooper That famous inventor and philanthropist was 20 years the senior of Captain Ford, but the two veterans saw eye-to-eye and the Captain sold his patent for a worthwhile sum

On the train en route to see Mr. Cooper in New York Captain Ford, due to his habit of striking up conversation with strangers who seemed interesting to him, had met General John C. Fremont He persuaded the famous soldier



Overhead lighting fixtures at the left are semi-circular, the mirrored wall gives full-circle illusion Structural flat glass, with sand-blasted designs, used at right

to permit him to attempt to sell some lands held in the west by General Fremont He made the sale and the commission he received from that, coupled with the sale of his patent to Peter Cooper, enabled Captain Ford to interest eastern capital in starting a plate-glass plant in Pennsylvania. This led to additional plants until all were merged into one large organization in Pittsburgh.

TWO sons, grown to mature business men, had joined Captain Ford about the time he built the Creighton plant and one of them, Edward, became the president of the Pittsburgh company. Edward Ford eventually resigned, and in 1898, purchased a 173-acre farm site adjoining the city limits of Toledo, Ohio, and built what later became America's largest plate-glass factory under one roof

Edward Ford, son of the "father of plate glass in America" (who passed on in 1903 at the age of 91) died in 1920 and exactly 14 years later the men who carried on helped to introduce a product—colored plate glass—that instantly made plate glass available in new fields

Plate glass was first made about 275 years ago Up through the years, scientific improvements in quality were the major goals as processes and equipment were improved, and its use by architects and designers increased accordingly, but there came a time when they said, in effect "We can't use clear plate in any other way Give us more color"

Colored glass had been made in Europe for many years, but, due to lack of demand in this country, little had been manufactured here

Sand is a principal ingredient in all glass, but for plate glass it must be of the finest quality to insure clarity Ottawa, Illinois, where much of the polished plate glass used for laminated safety glass is produced, is the hub for some of the best silica sand deposits in this country Known as St Peters sand it received its name from surface deposits near St Paul, along the present Minnesota River, formerly known as the St Peter River The deposits extend east and west, and from Minnesota southward into Arkansas In many places the deposits are 1000 feet under ground, ranging upward in shallowness to surface exposures Among the more important surface areas are those at Ottawa and Dixon, Illinois, 80 miles northwest of Ottawa, and in Calhoun County, Illinois, along the Mississippi

This sand is very white, exceptionally uniform in quality and has a low iron content—between 01 and 02 percent So high in silica content is this sand that it shines and sparkles almost like glass itself Most of us think of "fine white sand" as that found at Atlantic City and along Florida and California beaches, but, compared with St Peters sand, they would produce a glass of poor color.

Another fine grade of silica sand is quarried along the western foothills of the Appalachian range from southern New York state into West Virginia.

In 1934, the Toledo glass scientists introduced a variety of shades of blue in plate glass Three types of blue were selected—light, medium, and dark—and vision was possible through each Color control? Well the glass men licked that problem and the public reaction to the blues was so favorable that green plate was added, and then peach color. Was all this a great scientific problem? Well, it could be made to appear so, but it was more a matter of careful and tedious experimentation And there were some laughs, too

Take, for example, the time when some of the research group at the plant founded by Edward Ford were nosing around for the best ways to make golden plate glass, introduced commercially this year

One day a truckload of sugar arrived at the main entrance gates to the plant The driver wanted to know just which of the many buildings beyond the fence was to get it

THE gateman, not having been instructed, assumed that such an item as sugar must have been ordered by the manager of the lunch room operated on the grounds for the convenience of the office workers Some minutes later the lunch room manager, a rather quick-tempered chap, investigated the racket going on in the rear as the truck driver began unloading the sugar

"What's that stuff?" he demanded

"Eight hundred pounds of sugar," came the laconic reply.

"Eight . . hundred pounds," snorted the commissary manager "Why you big blankety zam zowie, I only have five sugar bowls I couldn't use that much sugar in five years Get t'hell outta here with that"

After some unraveling, it was discovered that one of the research men had ordered the sugar He had known that sugar, being a pure form of carbon, had often been utilized by bottle manufacturers to get an amber color

After experimenting with 800 pounds of sugar to arrive at a golden color for plate glass, however, he had to discard the idea of using carbon in this form, inasmuch as the resultant glass had "bubbles" in it

The terrific heat required to melt glass for proper handling makes it impossible to use some color ingredients ordinarily practical for other materials Any one of several faults in glass quality can develop No dyes can be used, of course, pigments are utilized exclusively and thus plate glass has only mineral coloring

It would require considerable listing to record all the coloring agents that were tried and rejected, but some of the minerals that get results include cobalt, chromium, nickel, copper, sulfur, antimony, selenium, uranium, titanium, manganese, and cadmium

All in all, Mr Webster's definition for glass seems inadequate. Glass is practically human. At least veteran glass men declare that during its manufacture glass has as many moods as some women . . . that you can never really be sure what it will do next

AN 'ENGINEERED' LILY PAD

"NATURE was the engineer," said Joseph Paxton when describing his great design, the famed Crystal Palace in London. To prove this, he exhibited a leaf of *Victoria regia*, the great water-lily of South America, and explained that "Nature has provided the leaf with longitudinal and transverse girders and supports that I, borrowing from it, have adopted in this building."

From an engineering viewpoint, the enormous leaf, or pad, of this lily is so interesting that we quote below some of the details from a *Journal of the New York Botanical Garden* article by H. W. Rickett.

One who sees for the first time a leaf of *Victoria regia* floating on the water is likely to ask himself "Would it hold me up?" It is said that the Indians, when they gathered the edible seeds ("water maize") of the water-lily, placed their children for safe keeping on the leaves (known to them as the "water-platters"). It is only necessary to place a board on the leaf to distribute the weight evenly over the surface. Indeed, if this precaution is taken, a large leaf will support a man weighing 150 pounds. One investigator reported pouring sand on to a leaf to the amount of 400 pounds before it sank. Considering the strength and buoyancy which this represents, it is the more remarkable that the texture of the leaf is very delicate. It is easily punctured by a small object falling from a small distance. This delicate blade floats as gently as a film of oil on the water, yet resists the depredations of animals and the impacts of waves and wind, and can support weights of several hundred pounds, providing only that the load is distributed evenly over the surface.

A group of the gigantic lily leaves at the New York Botanical Garden

The clue to this curious combination of qualities is seen on the lower surface. Here we find the structure to which Paxton referred in the words quoted above. The delicate flat blade is spread over a system of large ribs, Paxton's "girders," which radiate from the point where the stalk is attached. The ribs are narrow but deep, the free edge is somewhat broadened, but the web which connects this with the blade is quite thin. The main ribs of a comparatively small leaf are more than two inches high at the center of the leaf, and their thickened margins are less than an inch wide. Half way to the circumference they are one inch high and the edges only ¼ of an inch wide. These ribs are supported in a vertical position by cross-ribs, which run parallel to the circumference of the leaf and thrust against the sides of the main ribs, many of them are an inch high. These, in turn, are supported by sloping narrow buttresses firmly anchored in the leaf-blade, and holding the cross-ribs upright.

This is the structure, a product of nature in a remote wilderness, which inspired the design for a great exhibition building in a civilized country on the other side of the world. Ever since Paxton's day, the construction of greenhouses has involved similar principles.

Structural design does not cease with the gross arrangement of parts, but extends to minute internal details, the microscope is necessary to the understanding even of this enormous leaf. The ribs which appear so solid and massive are really structures of great delicacy. They are composed of air-filled tubes lying side by side, separated by thin membranes from their lateral neighbors and interrupted longitudinally by perforated partitions, the bulk of the great rib is actually mostly air.

To have its picture taken, one of the great leaves was turned over, as shown at right, so that its structure could be examined. Below is shown a close up of the "longitudinal and transverse girders and supports" on the underside of the leaf. These ribs give the leaf such strength that it will easily support several hundred pounds

Each tube is a structual unit which resists bending far better than would the same amount of material disposed in a solid strand. Therefore each rib, which is a bundle of such tubes, possesses great strength combined with lightness.

The air-filled passages are of value to the water-lily not only for the strength which they afford to the leaf but because they provide a means by which gases can circulate throughout the plant.

Mystery Of The Magnetic Mine

By C. E. MILBURY

BY this time, British naval authorities may or may not have solved the mystery of the so called magnetic mine. Our own Navy is doubtless cognizant of its general mechanical characteristics. Whether or not its secret has been solved does not alter the fact that nations readily concede it to be one of the most formidable and diabolic instruments thus far to make its debut in modern warfare. It is practically immune from attack. It renders the convoy system a true hazard instead of a means of safety. It attacks the vulnerable bottoms of even the heaviest of armed battle cruisers. Its presence cannot be effectively detected by any known device. The Burney or paravane method of mine sweeping is helpless against it. Several mines might strike the same target, insuring immediate sinking with heavy loss of life. It is light enough to be carried by planes.

It is easy to conceive the possibility of bottling up navies with mines of this type. Sinkings that are quick and certain are the specialty of this improved weapon; and unless effective ways and means are developed to combat its menace, the greatest navies in the world are at the mercy of the unseen undetectable, and unattackable.

The mystery mines are of two types. First, the inert shallow-water type, and, second, the mobile, deep-water type.

The mystery mine is comparatively light in weight since it requires no cables or anchors. this fact makes sowing by aircraft a practical possibility. Contrary to speculation, the present mine requires no parachute but may be dropped into the sea from a height of 200 feet, without damaging its mechanism or without detonation. The detonator does not become "alive" until the mine has been submerged and surrounding water pressure actuates a spring loaded hydrostatic trigger which sets the detonation circuit by piercing the seal on a small tube of mercury. This mercury fills a cavity containing the contact points of the detonation circuit.

One plane may carry a dozen magnetic mines and drop them as it flies low over the ocean shipping lanes of an enemy country. If the cargo is composed of deep-water mines, it will drop them from a height of from 100 to 200 feet directly into the sea and they will immediately sink to the bottom at depths up to 400 feet. What happens then may best be understood by an examination of the mine's mechanism as shown in the accompanying drawing.

The mine has three distinct compartments within a casing of non-magnetic metal. The upper one contains a battery, a magnetic device or grid, of the compass-needle type, several electrical circuits, and two hydrostatic diaphragms that work on opposite principles. The middle section contains the explosive with its detonation caps. The lower section contains an air flask that gives the mine its accelerated rising power after displacing its ballast water. Vent valves near the top of this compartment are held open by light springs, pistons close these valves when compressed air reaches them through small copper pipes connected with the air flask. At the bottom of the mine there is an opening through which sea water will enter when the mine strikes the water, the air being expelled through the open vents. The extreme upper compartment is connected to the lower or air compartment by a tube, the lower extremity of which is firmly screwed into the neck of the air flask, with its spring trigger-valve and its fuse seal.

THE mine's bottom is weighted for stability and the mine rights itself and sinks tail first. The mine descends rapidly toward the bottom and, at a depth of 70 feet, a diaphragm in the side of the mine near the top, set to operate at an external pressure of 35 pounds, moves inward. As it does so, it pushes a tiny piston which forces the seal from a small metal tube of mercury. The mercury makes a connection between two electrical contacts. This same operation also operates the solenoid and releases the brake on the magnet grid. Thus the mobile and detonation circuits are set, but not completely so, for another hydrostatic valve, pushed inward by water pressure, keeps open the final detonation circuit.

The mine finally reaches bottom and sea floor ooze closes around it. A ship approaches, and, at a distance of half a mile, causes the magnet grid to waver slightly. As the ship approaches nearer, the grid slowly deflects upward, finally pointing to an angle of 65 degrees. Things begin to happen. At this angle of deflection, the magnet grid makes a light electrical contact which, in turn, operates the fuse seal that restrains a spring-loaded valve of the air flask. The fuse melts, permitting the air valve to open, the blast of air thus released rapidly displaces the water ballast from the lower compartment through the hole at the bottom of mine, the air vents having been closed by action of their pistons. The force of the water-and air jet at the mine's bottom breaks the mud suction and the mine rises rapidly due to increased buoyancy and the jet's push.

Detonation occurs automatically when the mine reaches a level of 50 feet below the surface. This is caused by the outward bulging of the second hydrostatic switch which has been held in the open position by hydrostatic pressure. When that pressure is sufficiently released (at the 50-foot level), the switch closes the detonation circuit, and the explosion occurs.

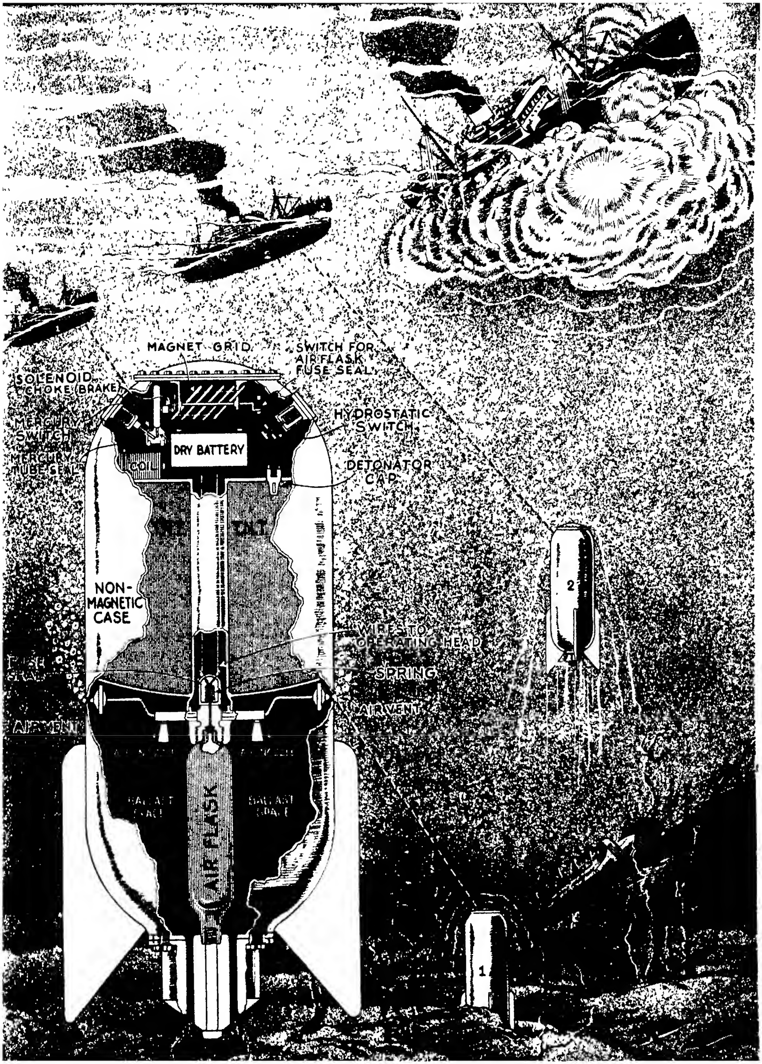
The possible elaborations that may be made in the way of further refining this mine are without possible limit and are to be gaged only by the cost of construction. The mine as now used positively does not follow a vessel by magnetic attraction, nor does not destroy by impact, its destructive action being like that of a depth bomb.

The inert mine, which is laid in channels and harbor entrances, is similar to the mobile mine, without the compressed air system and hydrostatic detonator. Being lighter, it may be more easily handled by plane. The inert mine creates all of its havoc without leaving its mud or sand bed, but the magnet in this case is adjusted to detonate at a deflection of 90 degrees. This insures its detonation only when a vessel is about to pass directly over it.

There will arise an important problem after peace has been signed, as to how the menace of these mines will be removed. They cannot safely be swept by wire dragging, for the dragging vessels would be destroyed. Even wooden vessels have some machinery that is magnetic and would therefore actuate the mines. Sailing vessels might be used with some effect, but perhaps the safest, most effective method would be to drop barrages of small depth bombs from airplanes. The best solution would be to construct such mines so that the grid would be disintegrated by electrolysis after a reasonable time.

●

At right: The ingenious, mobile, magnetic mine (German) powered by compressed air. The fish's-eye view shows approaching ship (1) _affecting magnetic grid_ so the mine starts rising; at (2), mine rises vertically as ship approaches; and our artist's conception of the explosion near the ship



MAGNET GRID
SWITCH FOR AIR FLASK FUSE SEAL
SOLENOID CHOKE (BRAKE)
HYDROSTATIC SWITCH
MERCURY SWITCH
MERCURY TUBE SEAL
DRY BATTERY
COIL
DETONATOR CAP
TNT
TNT
NON-MAGNETIC CASE
WIRES TO OPERATING HEAD
SPRING
AIR VENT
AIR VENT
AIR FLASK
2
1

SCIENCE AND INDUSTRY

A MONTHLY DIGEST

Conducted by F. D. McHUGH

Contributing Editor
ALEXANDER KLEMIN
In charge, Daniel Guggenheim School of Aeronautics, New York University

SCREEN MADE BY ELECTROPLATING

A NEW and unique development made possible by newly perfected electro forming methods is the production of metal screens, reports the magazine *Inco* The fabric is built up as a one-piece metal product wholly by electro-deposition, no woven or other foundation structure is included in the deposit

Screen being stripped from cylinder

The product is designed to serve purposes lying between those now covered by perforated metals on one hand and woven wire screen on the other It combines accuracy of hole diameters with the smooth surface characteristic of perforated metals Its percentage of openings lies between 16 percent and 50 percent of the total area, depending on design These figures are comparable with those obtainable in woven wire mesh Generally, the electroplated screen is used in the fine meshes below the limits of perforated metal Essentially, it supplements rather than competes with conventional woven wire

The plated screen, known by its trade name of Lektromesh, presents a smooth surface and is readily fabricated by drawing, stamping, welding, soldering, and the like It is stiff, tough, and strong Another special feature is the latitude in design which it makes possible The mesh can be of any shape and of a variety of sizes It has a unique quality in the fact that in some sizes and designs a two inch piece may be stretched to one foot It also can be designed to avoid heat conduction. Since it is an integral structure, it will not unravel.

Continuous production methods are used with such success that screen has been made in rolls 36 inches wide and up to 1400 feet in length.

In manufacture, the desired design is transferred by a succession of sensitizing, etching, filling, and surface treating processes to a metal plate or matrix These operations leave the metal surface of the matrix in a condition to receive the electro deposit uniformly where desired and yet allow it to be withheld where open spaces are necessary The matrix, when completed with its exposed and masked sections, is fastened to a circular cylinder which revolves in the plating bath As the cylinder revolves, the metal deposits are built up evenly and uniformly on the exposed areas of the matrix

Strip of electro-formed strainers

Thickness of the deposit depends on the current density used and upon the speed at which the cylinder turns The deposit in the form of a continuous sheet of screen is stripped off the matrix automatically.

Commercially, Lektromesh has been produced in sizes from 25 to 400 mesh, with the bulk of production to date lying between 25 and 150 mesh. "Wire sizes" have ranged from what in round woven wire would be .0008 to .025 of an inch in diameter

The complete processes of production are covered by patents held by E O Norris, Inc , under which the C O Jelliff Company holds exclusive rights

THE ESKIMO GOES MODERN

DENTISTRY has taken firm root among the Eskimos — literally

A Mackenzie Delta Eskimo had a tooth knocked out by a harpoon handle He had heard of the white man's false teeth and, after pondering the matter for a while, he carved a tooth from ivory, root and all and drove it into his jawbone with a mallet

According to Philip H Godsell, who tells the story in an article in *Natural History*, the magazine of the American Museum of Natural History, the man was apparently none the worse for his painful but effective bit of dentistry

MOUNTING TIRES WITH AIR PRESSURE

THE need for injurious pounding of tire beads in mounting tires on automobile wheels has been effectively eliminated by the Safe-Way Pneumatic Tire Mounting Tool, a product of SafeWay Tool Company

Air mounts a tire

This lightweight aluminum tool uses air pressure to mount tires noiselessly and safely.

The tire is hung on the wheel in the usual manner, then the Safe-Way tool is hung on the rim, in contact with the lower exposed bead An air hose is connected to the tool, and, in the short space of three seconds, the tire is in place on the wheel No pounding of the bead, no missing the tire with the hammer and damaging the wheel paint A noiseless mounting job is done in a jiffy.

To keep the weight of the Safe-Way tool down to a point where one man can handle it, aluminum alloy castings are used for most of the parts The entire tool weighs only 18 pounds, and exerts a pressure of one ton when working on an air pressure of 125 pounds

Pavement Roughness Recorder

IN constructing highways it is necessary to eliminate waves and humps which would affect motor-car speed and comfort Hence, after a pavement is laid, these humps are hunted out and rubbed down Many types of devices have been worked out for the hunting job but until development of the Viagraph there was no satisfactory recording mechanism

The Viagraph, which was recently discussed in *California Highways and Public Works*, produces a graphical representation of the road surface The present instrument is a further development of a surface meter first made by Mr Claran F Galloway "Essentially, the road surface meter is the same as the original Galloway instrument," says Mr Douglas H Greeley, writing in the above-mentioned magazine "Some improvement in design and construction was effected and a totalizer to record the travel of the graph pen has been added In addition, an odometer was also added so that engineer's stations or distance might be observed"

As shown in the accompanying illustrations, the wheels of this instrument make a three point, in-line contact with the road surface When this device is operated at a walking speed, it is steered by turning the handle in a manner similar to that of the throttle control on a motorcycle The recording mechanism is operated by the middle wheel which is mounted in a "floating" position, the pen being raised or lowered on the graph paper as the instrument is wheeled over an irregular surface.

"During operation," says Mr Greeley, "the chart paper progresses at the rate of one inch each 20 feet, the pen movement being at a ratio of two to one, that is, a bump one quarter inch in height will be drawn one half inch in height on the chart As this process continues, the pen's movements, in a positive direction only, are measured by the totalizer and recorded by its dial This is accomplished by an over riding clutch which allows the negative movement of the pen to occur without measurement. Also during this process, the distance is recorded on the odometer dial"

One-Eyed Spectacles

THE eyeglass of the future — a million years or so hence — will look like the model designed by Pitt H Herbert, of the Bausch & Lomb Optical Company, if biologists are correct in the assumption that Nature is gradually working toward a single eye in the center of the face Tests show that many people have a dominant eye which does most of the seeing, just as most people are right handed The dominant eye often does 90 percent of the seeing

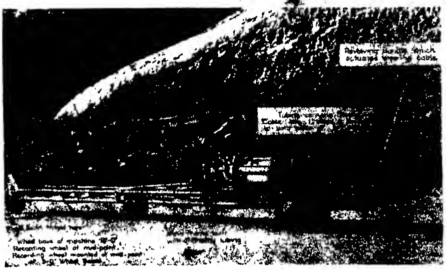
The effect of a dominant eye is to decrease stereoscopic vision Things look flatter Some biologists, looking thousands of years into the future, suggest that in time all our seeing may be done with one eye and that, in effecting the change, Nature will have moved the eye to the center of the face, perhaps in the middle of the fore head, turning us into a race of Cyclopes

For the future?

Fruit Flavors

THERE are so many fruit flavors used in cakes, pies, ices, and soda-fountain drinks that it is usually taken for granted that these are natural fruit flavors However, there are but few pure fruit flavors now on the market and most of these are not satisfactory The processes of manufacture now in use permit undesirable changes to occur These changes alter the flavoring and make it less desirable than the synthetic or imitation flavors derived from coal tar and other organic products The problem presented here is not a new one Many researchers have endeavored to perfect a process of extracting the unchanged flavors.

In announcing that a study of the preparation and manufacture of pure fruit flavors from strawberries, raspberries, and cherries has been undertaken at the New York State Experiment Station, that station announced that it might even be necessary to blend new flavors of fruits which will yield especially potent flavors that can be easily extracted This new project has been set up under the terms of an industrial



General view of pavement roughness recorder and (*below*) close-up of chart

Above: A proposed type of autogyro carrier for protection of shipping. *Below:* Artist's drawing of a 'gyro patrol plane landing on a platform built on a freighter

fellowship sponsored by one of the large food corporations, Fletcher Chase, a chemical engineer, is now engaged on this project. Should success attend his efforts, new and larger markets for flavors might be found than that now commanded by the synthetic flavors trade, estimated to be in the neighborhood of one million dollars a year.

New Rubber-Metal Adhesive

THE sharp demand for bonding agents that enable manufacturers to wed rubber to metal and Thiokol "synthetic rubber" to iron, steel, lead, and the like, is producing real results. Latest result is Ty-Ply a non tacky adhesive marketed by the R. T. Vanderbilt Company. This adhesive is of two types: Ty-ply "R" for rubber and Ty-Ply "S" for Thiokol.

Using this adhesive, manufacturers can brush or spray practically every metal with a thin film. Within a very few minutes, this Ty-Ply film dries sufficiently to receive the layer or sheet of rubber or Thiokol to which it is to be bonded. The assembled product is then placed in molds and inserted in a vulcanizer. Upon completion of a short vulcanizing cycle, the mold is emptied to reveal an exceptionally strong single unit. Besides being non-tacky, the new adhesive is economical to use because the thinnest film gives the best bonding results with metal.

The development of such adhesives, researchers contend, is hastening the day when it will be practical to protect tank cars, vats, and other metal equipment with linings of oil proof, grease-proof "synthetic rubber."

Battle for "Kerosine"

WEBSTER still insists that it be spelled "kerosene," but for 15 years the American Petroleum Institute, the American Society for Testing Materials, and a few hardy publications and individual converts have weathered mild and sometimes bitter abuse by joining in an orthographic adventure to promote the spelling which they believe is correct "kerosine."

Proponents of "ine," slowly growing in numbers, point out that gasoline, benzine, and kerosine all are coined words having no strict chemical meaning. The "ene" ending, as in toluene, benzene, and other words, indicates a definite chemical compound. Since the ending of kerosine should have no chemical significance, they say, it is much to be preferred that the ending correspond with those other coined, non chemical words, than that it have an ending which might possibly be confused with the chemical "ene" words. Gasoline began its life with both endings, but finally settled down to the more logical spelling. For some unexplained reason, however, the 'ene' became firmly attached to kerosine.

Even if Webster and other official arbiters of orthography do adopt "ine," however, the present proponents feel certain that for decades the mails will continue to carry a steady flood of letters beginning, "I liked your article, but why don't you spell that word right?"

Germ-Free "Blood Banks"

SULFANILAMIDE, powerful chemical remedy for a host of germ diseases, is now being used to make blood transfusions safer. A small amount of sulfanilamide added to blood that is to be stored in blood banks for future transfusions prevents the growth of bacteria in the blood for from 10 to 15 days and may even make the blood completely germ-free. Details of the method were recently reported by Dr. Milan Novak, of the University of Minnesota.

Some of the serious reactions occurring after blood transfusions may be due to unsuspected germs in the blood given, Dr. Novak points out. Blood for transfusion is always tested for syphilitic infection before use. Tests for other germs which may lurk in the blood of healthy donors are not always made. Germs can also get into the blood when it is drawn from the donor or in preparing it for storage, in spite of precautions that are always taken against such contamination. — *Science Service*.

Rotorcraft Patrols for Merchant Shipping

EXTENSIVE studies of the possibility of protecting merchant shipping by the use of autogyro patrols has been made by R. G. Kellett of the Kellett Autogyro Corporation. The results of these studies were made public at the recently held Second Annual Rotary Wing Aircraft Meeting in Philadelphia.

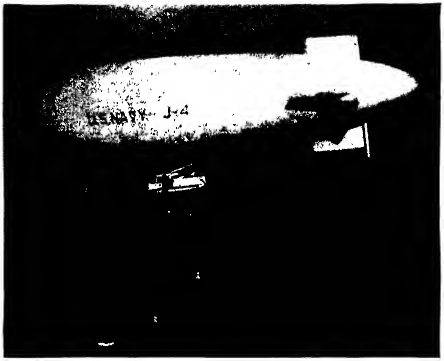
Modern autogyros, with jump-off characteristics, can operate on platforms no greater than 40 by 60 feet, which can be installed on most sea going craft. One of our photographs shows an artist's conception of such a platform. Tests with conventional aircraft indicate that visibility can be obtained to a considerable depth below the surface of the sea. A 'gyro patrol could therefore readily locate mines or submarines, and its pilot destroy them with depth charges or bombs. Under such a plan, surface vessels would carry patrols of two or three 'gyros, so that there would be constant protection even when one or more of the aircraft were being serviced or refueled. (See also page 339, December, 1939, Scientific American—*Editor.*) An alternative proposal, shown in another illustration, would be to use a converted tanker or freighter as an autogyro carrier.

The suggestion is timely and deserves full consideration by the navies and merchant marines of a number of countries.—*A. K.*

Lessons in Military Airplane Design

WHAT is the best possible way of learning the requirements of the military design of aircraft, short of taking part in aerial warfare? Answer: To study every bit of news that comes through the censor's hands. Is the speed of the Messerschmitt useless in comparison with the greater maneuverability of the Curtiss Hawk? Then too high a speed, and too high a wing loading (militating against maneuverability), must be avoided. Is the new Messerschmitt, equipped with two 1000-horsepower engines, and carrying a really

long range cannon more than a match for the Spitfire? Then we must give attention to twin-engined pursuits, similarly equipped with cannon Can bombers, with adequate machine-gun fire, reach their objectives and fight off a swarm of enemy fighters? If not, the long-range bombers must be supported by single seaters having a similarly long range. Needless to say, combatants in the present struggle are ardent in such studies. If the British and French missions have delayed a little in placing large aircraft orders, then it is because they are studying reports of this character before deciding on policy and types —*A K*



Rubber boat approaching a blimp moored at sea

Anchoring Small Airships at Sea

FROM Commander J. L. Kenworthy, Jr, of the Lakehurst Naval Air Station, we have received a first-hand account of the excellent methods which have been developed by the Navy for anchoring small airships or "blimps" at sea

There are two main problems in anchoring the blimp, one is to achieve static equilibrium, the other to hold the ship at rest against the action of the wind with engines not running, or merely idling

At the end of a journey, the airship has consumed a certain amount of fuel, and is therefore light To release helium from the gas bag is too expensive. In a large rigid airship, the exhaust gases are cooled, the vapor condensed by cooling adds ballast to the ship and restores equilibrium But a water recovery process is too bulky and clumsy for use on a small airship

So the problem of making the ship heavy at the end of a voyage has been solved in a novel and ingenious manner Suspended from the front of the airship car by two vertical cables, there is a large, conical shaped water ballast bag The lower tip of the bag is connected with the rear end of the car by a haul in rope of suitable strength By a method which is still regarded as confidential, the conical bag can be filled with a desired quantity of water, and then drawn above the surface of the water At the same time, ballast is dropped from the airship to about 50 percent of the weight in the conical water bag The buoyancy of the gas bag itself now holds the ship in taut equilibrium.

Thus the first problem is solved in a simple yet effective manner The second problem was solved by an improvement in the use of a drogue or drag anchor The drogue consists of a flat metal cone which is payed out by a wire from the front of the ship The nose mooring-point seems to be best suited for the drogue wire The drogue is connected to the pay-out wire by a four-legged bridle, and is kept in the proper position, free from the influence of surface waves, by a weight below and a rubber float on top By adjusting the legs of the bridle, the pull can be adjusted in direction and to some extent in magnitude With this drogue, the ship can be kept at anchor, it can also be steered and the airship can be maintained at rest at various angles to the wind direction

The story does not end here, however The top opening of the water ballast bag is closed by a heavy wire mesh on which a person can stand, but through which water can escape or enter freely The two vertical cables (which are partly ordinary cable and partly shock absorbers) are connected with ordinary ladder rungs to permit communication between the surface of the water and the airship car The freedom of action of the blimp is further enhanced by the fact that fuel, provisions, and so on, can be hauled on board from a surface vessel, by means of an electric winch — *A. K.*

Demonstrating, by television, the operation of an aircraft engine

Television Broadcast of an Aircraft Engine

ONE of our photographs shows Ronald S Gall, of the Wright Aeronautical Corporation, busily demonstrating for the first television broadcast of the operation of an aircraft engine The Wright 1100 horsepower, nine-cylinder Cyclone was cut away and revolved by an electric motor N B C actually staged the show under the auspices of the Air Transport Association Such television broadcasting has real possibilities of an educational nature. — *A. K*

100 Horsepower, 100 Pounds, $100

WE do not always agree with William B Stout, noted aeronautical engineer and designer, in his conceptions, and he does not always bring his brilliant conceptions to commercial fruition, but no man has a more vivid and stimulating imagination in technological matters Writing in *Aero Digest*, he gives us a slogan which is fascinating: "An engine of 100 horsepower; weighing 100 pounds; at a cost of $100."

. . . a capacity of 157,750 gallons per minute

This is a splendid goal to shoot at, we are badly in need of inexpensive and light engines of 100 horsepower for private flying High revolutions per minute, in a six-cylinder opposed, flat or pancake type of motor, which, if desired, can be hidden inside a wing, is Mr. Stout's solution — *A K.*

CANDLE-POWER

SOMEONE has estimated that a half ton of candles would be required to produce the amount of light used monthly by the average family. The cost would be about $350 as compared with the electric light bill of that average family, which is about $2.50.

Slush Molding Phenolic Resins

WHITE metal and other materials have long been slush molded — that is, poured into a mold and agitated until a shell of the material cools in all parts of the mold and a hollow casting results This process has now been adapted in the plastics field so that hollow castings of plastics may be obtained

With metal, slush molding is relatively simple because the metal chills and hardens quickly on the inner surface of the mold. The problem with plastics was more difficult, for a hardening accelerator had first to be discovered This has now been found and a large variety of hollow plastic castings can be made, including advertising displays, lamps, souvenir novelties, and a number of other products

Latex rubber is sprayed on the model to be reproduced, and allowed to cure to the proper consistency Then a fairly heavy coat of plaster of Paris is spread over the entire outer surface of the rubber. This plaster-and-rubber mold is cut away from the model, fitted with dowel pins, and assembled as a rubber-lined plaster slush mold ready for production.

Liquid resin, properly accelerated, is then poured into the orifice of the mold and agitated by revolving or slushing the mold for a period of 15 to 20 minutes The accelerator cures the resin to the necessary hardness in this time, after which the mold is disassembled The resultant casting faithfully reproduces detail, and has a sectional measurement of 1/8 to 3/16 of an inch The casting is found to be light, tough, and translucent. The natural ivory color of the resin (the only color which is available) may be complemented by the addition of such lacquers or spray paints as will emphasize its best characteristics

If properly handled, the mold can be used for about 150 castings.

Gun Fires Wire on Parachute

MUCH has been written of the balloon barrage over London, the cables of which are intended to entangle enemy bombers In our December issue we described a further entangling device consisting of small free balloons supporting a wire at the end of which was attached a bomb. Both of these defenses should prove very effective.

The United Press reports a third entangling device which consists of a steel ribbon hundreds of feet long which is supported by a parachute after being fired in a shell from a big gun. This is an American invention but is now being experimented with, says the United Press, in France The trick of the invention is said to lie in the method of coiling the wire within the shell. That shell is described as being about 6-inch caliber, and is fired from guns in regular fashion. When it reaches its highest altitude, the nose falls away, uncoiling the wire as it falls and dragging out the parachute which then supports it for a slow descent to the earth

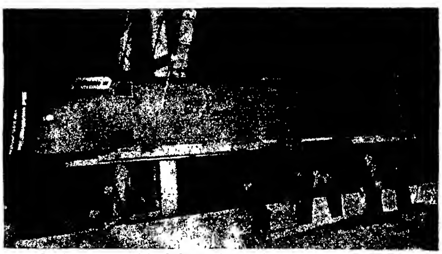
It is easy to see that a barrage of shells of this type would quickly form a veritable network of wires dangling in the air, unseen by enemy bombers. Any one of those wires, caught in a propeller or on some part of the plane itself, would bring it down

A Match for Eighty Fire Engines

EIGHTY of the largest fire department pumpers, working at full speed, could barely produce a torrent of water equal to the stream the strange looking device in our illustration lifts into the main powerhouse at the Rouge Plant of the Ford Motor Company in Dearborn, Michigan It is the impeller of a vertical lift pump which has a capacity of 157,750 gallons of water per minute, compared with a maximum capacity of 2000 gallons per minute in a fire department pumper Every 24 hours four of these huge pumps bring as much water to the steam condensers in the power house as is used in the same length of time by a great city The water comes from a 15 foot tunnel which connects the plant with the Detroit River, two miles away The impeller was photographed recently while undergoing a minor repair in the Ford tool and die shop It is six feet in diameter and more than 20 feet long

D. C. Locomotives

THE accompanying illustration shows the first of the four most powerful D C locomotives in the world, built by General Electric for Paulista Railways of Brazil, being loaded on the S S *Santos* in Brooklyn for shipment to Santos, Brazil. For high-speed passenger service, this locomotive and the three to follow weigh 185 tons each and have a top speed of 93 miles per hour. They have a continuous rating of approximately 4200 horsepower, and a one-hour



Loading a powerful D. C. locomotive for shipment to South America

rating of 4560 horsepower—a rating higher than any other direct-current locomotive now in use either in this country or abroad. They are powered by 3000-volt motors.

The Paulista locomotives have a gage of five feet, six inches, and in order to test them, the Erie G-E Works was required to lay a special wide-gage track. Paulista Railways has a large number of electric locomotives in service.

RESEARCH

During 1939, approximately 2000 individual companies spent some $215,000,000 for industrial research. Two leading companies in this work for progress were du Pont with a research budget of $7,000,000 and Dow Chemical Company with one of $1,400,000.

Milkweed Enzyme Makes Steak Tender

The lowly milkweed can be made to yield a rare derivative that aids digestion and makes tough steaks tender, it has been revealed.

Asclepain, the new derivative, is a proteolytic enzyme, which breaks down the protein in foods into more simple, easily digestible substances, it was reported. Only one other plant has been found to yield a similar substance—the papaya, source of papain.—*Alcohol News*

Machine to Cure Athlete's Foot

Knowing that it has long been established that copper is an excellent fungicide, researchers A. G. Conrad of Yale University and Dr. Howard W. Haggard worked out in the laboratory some months ago a process for what amounts to an impregnation of the skin of the feet and hands with electrolytic copper to destroy the fungus which causes "athlete's foot." This impregnation was accomplished by an electrolytic method of depositing copper

To destroy athlete's foot fungus

Treating fungus infection of hand

under the skin from a solution, and was discussed in the June, 1939, issue of Scientific American

This process has now been reduced to practice in a machine made by Mine Safety Appliances Company and called the M S A Rheoderm, which treats fungus infections of the hands and feet by the iontophoresis of copper This machine is a relatively simple electrical apparatus that can be operated by any doctor, and is absolutely safe It introduces metallic copper into the deeper layers of the skin without injury to the skin or discomfort to the patient. The majority of patients so far treated with the instrument have experienced prompt and gratifying relief from all symptoms of athlete's foot, indicating that the method possesses efficacy that will be widely welcomed

NAVAL GUN CONTROLS

AFTER the recent battle between the *Graf Spee* and three British ships off the coast of Uruguay, so many newspapers commented on the fact that guns had to be hand-pointed after certain controls had been smashed that some readers have asked us for details concerning the manner in which guns are operated on naval vessels

There are two methods of controlling the fire of the guns of a capital ship One of these is called "director" fire, the other "pointer" fire.

The normal method of control in a modern battleship would be "director" fire. This is essentially a "follow-the-pointer" system Here the gun pointer, the man who lays the gun in elevation, and the trainer, the man who lays it in azimuth, both do their job by matching pointers One of these is actuated by an electrical transmission gear, the other is mechanically geared to the gun-elevating or gun-training mechanism The electrical impulses for elevation emanate from the plotting room, down deep in the ship, where ranges and spotting data are analyzed, and sent out over this repeating system to the various gun mounts. The impulses for training come from the particular "target bearing transmitter" that has control at the time. This latter is merely a master sight, generally in a position of great elevation, that is kept

constantly trained on the target manually. The actual firing is done from the control tower or whatever unit has control. The work of the gun crew is mainly to load and unload the guns. Of course, each gun or turret has its own switch, and the guns can not be fired until these switches are thrown, at which time the "ready" lights will show in the control tower. The check sights are manned, however, to be sure the "follow-the-pointer" system is functioning.

The impulses for training, in the "director" fire method, do not flow directly from the "target bearing transmitter" to the gun mount. They are fed into range clocks — more often called rangekeepers — in the plotting room. The whole fire control problem is analyzed on these rangekeeping machines, and the impulses for both elevation and train are sent from the rangekeeper to the gun mount. The other data that are fed mechanically to the rangekeeper are the ranges, which come from the range-finders, and the spotting data (corrections) sent down by the officer who does the spotting. The latter is available, of course, only once the battery has opened fire.

"Pointer" fire is essentially individual operation of the guns. This would be necessary were the control tower shot away, or the fire control system generally put out of commission. The plotting room sends out its ranges and deflections over electrically operated visual signal systems. The sightsetter sets his sights to these values, the effect of this being to displace the axis of the gun from the telescopic sights by amounts calculated to take care of the range and deflection. The pointer puts the horizontal cross wire of the telescopic sight on the target, the trainer puts the vertical wire on. It is the pointer who fires when the firing signal is given — or as soon thereafter as he is "on" the target. Should the plotting room cease to function, the officer in charge of the battery, or the gun captain, would call out the ranges and deflections as best he could, and continue the fire on his own control.

In addition to these, it may be stated that some experiments have been made with what is called "remote control" direction of the guns. Here the control extends actually to laying the guns in elevation and in train by power mechanisms, eliminating the "follow-the pointer" personnel and leaving only the loading and unloading of the battery for the gun crews. This has not generally been applied to large turret mounts, being used more for the lighter anti-aircraft guns.

Aluminum Tinning Flux

THE difficulty attending the job of soldering aluminum has become traditional. Of great significance, therefore, is a new tinning flux for aluminum, which makes possible simple soldering with commercial solders. Called Amco, this flux is a product of the American Solder and Flux Company.

To tin aluminum, using Amco, it is necessary that the metal be properly cleaned and preferably roughened. On thin sheet metal, either a clean source of heat or an extra hot soldering iron may be used. On cast aluminum or aluminum alloys, the heat is supplied around the surface or from the opposite side. When the flux is applied to the surface and heated, the action is at

first the same as with ordinary flux, but as the heat is continued, a heavy white vapor is given off. With this action, the deoxidising and tinning of the metal takes place, after which ordinary tin-and-lead solder may be used

MEDICINE

THE dried and powdered bodies of five poisonous creatures are still used as medicines in China. According to *Natural History* magazine, these creatures, often depicted in jade carvings, are the lizard, the snake, the toad, the spider, and the centipede.

Swedish Instrument for Locating Cables

A NEW instrument, which makes it possible to locate accurately and rapidly underground cables and piping, has been constructed by a Swedish firm, the L M Ericsson Telephone Company, of Stockholm

The device consists of three separate parts a transmitter buzzer, a cable finder with built in frame aerial, and a finder coil The measurement is based on the principle that an electro magnetic field produced by an alternating current in a metallic conductor can affect a telephone receiver circuit The alternating current is produced by the transmitter buzzer, which is connected to one end of the cable or pipe to be investigated, and also to the earth By carrying the cable finder in the direction of the cable, the exact position of the latter is easily determined through the intensity of the sound in the ear phones, which is strongest right above the cable.

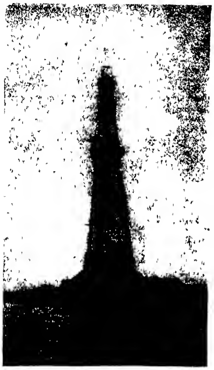
In this way can also be fixed the exact place of an earth leakage, since the electromagnetic field, and therefore also the sound, disappear at such a place It sometimes happens that an earth leakage has arisen without it being possible to discover any visible injury to the cable armor after excavation It is then that the third part of the instrument, the finder coil, is employed With its aid, the precise point of the fault is fixed Experiments also have shown that in cases where several cables were lying together, the one connected to the transmitter buzzer could be found without difficulty through the coil. Another feature is that a low-tension power cable without a fault does not need to be put out of service if its route is investigated by means of the new method.

The cable finder also can be used with success in locating gas and water mains. —*Holger Lundbergh.*

Oil From Under the Ocean

MORE and more oil is being taken from wells drilled under the ocean some distance from shore Large numbers of wells have been drilled on the California coast from the extreme ends of piers stretching out into the water. However, in Galveston Bay this under-water drilling needs no connection with the shore, mainly because of the shallowness of the water.

According to the *Standard Oil Bulletin,*



Discovery well in Galveston Bay

seismographic surveys were made on the floor of Galveston Bay covering an area of 236,000 acres Later, a detailed survey was made of 48,000 acres of the original 236,000. Both jobs were done by crews living in a houseboat and working from special barges and boats This work resulted in the discovery of a buried dome and the first wildcat well drilled on this dome became a discovery well at a depth of 6030 feet. Two more wells were drilled — these being drilled from pile foundations as was the first It was then found advisable to change the method of drilling, and so a barge was put into use By this method a large barge, to provide a drilling platform, is filled with water and sunk over the location for a well. Drilling is done from a rotary table which stands up above the surface of the Bay Throughout the work area, the water is not more than 12 feet deep, and when one well is completed, it takes only from 12 to 18 hours to lift the barge and move to a new location

There are now 11 wells completed and two are in process of drilling The discovery well is about one mile from shore and the others vary in distance from three quarters of a mile to two miles.

New Pneumonia Treatment Announced

A NEW chemical treatment for pneumonia, using a new drug, sulfathiazole, has been announced to the medical world. Physicians who tested it experimentally on human patients, reports *Science Service*, pronounce it even better than sulfapyridine, widely hailed in recent months as the chemical conqueror of pneumonia.

The new drug is safer than sulfapyridine, and it does not make the patients sick. Nausea and vomiting, which have been a distressing feature of sulfapyridine treatment, are practically absent when sulfathiazole is given, physicians report.

Laboratory experiments on hundreds of mice show that the toxicity of sulfathiazole

See our other advertisement on page 189

is much less than the toxicity of sulfapyridine, except in doses far larger than are needed to cure pneumonia.

In the body, sulfapyridine is rather rapidly combined or conjugated with acetic acid. This unfortunately makes the drug inert and useless in its effect on the infection, only the uncombined form being active. The new drug, sulfathiazole, however, combines with acetic acid to a much smaller extent, so that most of the drug given is effective until it is excreted. This means that doctors do not have to give as much sulfathiazole as sulfapyridine to treat a pneumonia patient. Chronic poisonous effects from accumulation of the drug in the body are much less apt to occur because sulfathiazole is excreted more rapidly than sulfapyridine.

FILTERS

"BLACK-OUTS" in warring countries usually necessitate painting factory windows, so that electric lights are necessary in the daytime. In England, complete obliteration of windows is obviated by use of blue windows and orange lights inside. During the day some daylight is transmitted, but at night the blue glass will **not** transmit outwardly the inner orange light.

"Invisible" Glass Camera Lenses

A METHOD of coating camera lenses with evaporated metallic fluorides, which greatly increases the effective speed of lenses, produces a marked improvement in contrast under adverse lighting conditions, and eliminates flare and ghost images, was recently announced by Dr. C. Hawley Cartwright of the Department of Physics of the Massachusetts Institute of Technology.

Dr. Cartwright presented a paper in which he reported studies of a highly corrected $f/2$ lens composed of five separate elements on all surfaces of which a fluoride film had been deposited. The effective speed of this lens was increased nearly 100 percent. The extent of the improvement by coating, he reported, depends on the complexity of the lens. The increase in speed obtained by coating a three-element $f/3.5$ lens was much less than for the $f/2$ five-element lens.

The method is an outgrowth of Dr. Cartwright's earlier work with the help of Dr. A. Francis Turner, which resulted in reducing reflection and adding to the transmission of light through glass. It is well known that faster and more highly corrected camera lenses require a large number of separate elements. Each separate element reflects about 10 percent of the incident light. Thus, good camera lenses ordinarily have transmissions of only about 60 percent.

Dennis Taylor observed in 1892 that tarnishing of camera lenses tends to increase their effective speed. The tarnished surfaces of the glass elements of high refractive index diminished the reflection of light from the air-glass surfaces and thereby increased the transmission of the whole camera lens. Various methods were devised for artificially tarnishing glass, but

apparently the results were not sufficiently effective to justify their adoption by the manufacturers of camera lenses It is now evident that the tarnish is actually a film of a transparent material having a lower index of refraction than that of the glass and to be most effective should fulfill specific conditions which can be better satisfied by the evaporated films of the metallic fluorides.

The evaporated metallic fluoride film, Dr Cartwright said, has proved effective for many optical instruments Since the film must be deposited in a vacuum and since each of the many elements in a camera lens should be so treated, the method is much more easily applicable in the manufacture of new lenses than in the treatment of ones already in use

In Case of Accident

IN motor accidents alone, one spine is fractured every hour of the 24, according to H Earle Conwell, M D, a Birmingham, Alabama, physician, writing on "The Automobile and the Fractured Spine" in the *Journal of the American Medical Association.* The most common type is the compression fracture, and, "without a doubt," Dr Conwell says, "certain lives ended in

Wrong . . . and right

the past by motor accidents could have been saved and permanent disabilities prevented by proper first aid "

Witnesses wishing to be helpful after an accident sometimes rush up excitedly, hoist the injured into the air as in the upper photograph of the pair on this page, and carry him away The correct way to transport a person in whom an injured spine is suspected or possible, and when no stretcher is available, is shown in the lower photograph The reason is explained by Dr Conwell.

In riding, the torso of a passenger is usually braced somewhat at the lower end by the legs When the accident comes, the chest and head are thrown forward This often causes a jackknifing at some part of the spine and the effect is often to crush or partly crush the *front* side of one or more vertabrae. Obviously, the carrying position shown in the upper photograph further forces the crushed vertabrae together, but the second position, the correct carrying position, has the opposite effect.

Many fractures of the spine are not recognized, Dr. Conwell states, because the patient is able to walk after the accident.

The patient often under-estimates his injury, frequently stating that he has a "kink" in his back and that the disability is of no importance. Frequently there is no deformity of the back, though there is always a backache of varying severity Regardless of the insignificance of the injury, he urges, one should feel suspicious of a spinal fracture when pain in the back is present

Dr. Conwell goes on to state that to many laymen a broken back or neck is a broken back or neck, which results in sudden death or paralysis—total disability This gloomy point of view is the heritage, he adds, of days before the introduction of the X-rays. With existing treatments most patients may be expected today to recover and return to their occupations

Cellulose Pulp From Australian Tree

WOOD pulp for use in paper, guncotton, textiles, and the thousand other uses of cellulose may be grown on "tree farms" of limited acreage in the warmer parts of the south, through the adoption of a fast-growing Australian tree, casuarina, is the belief of Prof Donald D Bode of the University of Tampa chemistry department

Casuarina trees will grow 35 feet high with nine inch trunks in six years, 56 feet high with 17-inch trunks in 12 years. They will produce from four to six cords per acre per year, as compared with one cord per acre per year for southern jack pine Moreover, a cord of casuarina wood is one fourth heavier than a cord of jack pine

The Florida state forestry service estimates that to supply a 200-ton mill with slash pine, 120,000 acres under forest management are needed The same mill could be supplied by a 24,000-acre tract of casuarina.

The tree can be grown on poor soil, down to the very edge of salt water It must not be attempted, however, except where winter temperatures do not drop below a mean of 54 degrees, Fahrenheit, for the coldest month, and it must be carefully protected against fire, to which it is unusually sensitive.

The casuarina is a strange-looking but beautiful tree It has no leaves, their place is taken by extremely slender, long, jointed green twigs, somewhat resembling the common horsetail or scouring-rush — *Science Service.*

CRYSTALS

THE tiny crystals which are regimented, line after line, to make Polaroid, are so small that three billion of them would just about cover the head of a pin 1/16 of an inch in diameter.

Dry Method, Positive "Blue Prints"

SINCE the beginning of blue printing more than 40 years ago, there has been a constant search for a dry method of making positive prints Blue printing is a five-step process employing wet development, necessitating such operations as washing, fixing, drying, and the like. Moreover, blue prints fade when exposed to light. They

are negative in type and therefore hard to read.

A new method called the Ozalid process provides not only a positive print but also utilizes dry development The resulting prints consist of dark lines on a white background. They are contrasty, sharp, and easy to read. Since no liquids are used in developing prints, they do not wrinkle or shrink and are true-to-scale of the original

The Ozalid process is a contact method of reproduction and, as such, depends upon the transmission of light through the original for the reproduction of prints Ozalid sensitized materials can be handled in daylight It consists of two simple steps—exposure and dry development Exposure is made in sunlight or by an arc or mercury-vapor lamp The actinic light rays given off by these types of light sources convert the yellow sensitized surface to a colorless salt except where the surface is protected by the lines or opaque image of the original subject The subject matter may be pen or pencil lines, typewriting or printing The exposed print is developed dry in a few seconds by the application of ammonia vapors in a dry-developing machine

Acid-Resisting Pump

A NEW pump designed for use in evaporative coolers, chemical laboratories, and industries requiring an acid-resisting pump has been developed by The Air-O-Line Company Made of stainless steel and

mounted on a vitreous porcelain enamel stand, it is made in three sizes ranging in capacity from 140 to 360 gallons per hour

This completely self-contained unit has a height of only $8\frac{1}{2}$ inches, and in operation the impeller unit is to be submerged from two to four inches The motor is for 110 volts, 60 cycles alternating current

Replacing Carnauba

THE American chemical industry has been shown to be elastic and adaptable in many cases since the present war in Europe began The latest evidence to that effect is the successful replacement by Foster D. Snell, Inc., of a large proportion of the carnauba wax in water waxes by other materials having a free and open market. Car-

nauba wax is an important ingredient in many widely used formulas, particularly for making floor waxes Yet carnauba is hard to get because of the war and there has been erratic fluctuation in prices

One specific replacement product has gloss and other properties similar to the usual gloss drying waxes, yet it contains only 34 pounds of carnauba wax per 100 gallons.

Oiled-Earth Paving

ONE day back in 1929, Paul E. Tignor, field engineer for The Glenn L. Martin Company of Baltimore, accidentally upset a small can of lubricating oil which he was using on his lawn mower in the back yard at his home The oil penetrated a mass of red clay and Tignor, always of an inquisitive turn of mind, bent down to examine the oil soaked mass of earth He found that, in its oily condition, it could readily be mixed into a sort of dough

This gave Tignor an idea, and from that simple beginning he developed a wholly new paving process particularly designed for use on airport runways and which has subsequently been adopted as a standard surface in many municipal airports

At that time Tignor was seeking a long-wearing, water-proof surface for a 1600-foot airplane runway which he was about to construct for the Martin company at its Middle River plant near Baltimore He continued his experiments by mixing various types of oil, asphalt, and the like, with the native sand, clay, and gravel of the area until he found a satisfactory combination That the formula was a good one has since been evidenced by the fact that the runway he laid down in 1930 is still in an excellent condition

Correction

IN giving the dimensions of the roadway on the pontoon bridge across Lake Washington, at Seattle, in our February article, "A Bridge That Floats," it was stated that there would be 24 foot sidewalks This was a typographical error, it should have read "two 4 foot sidewalks."

Trichinosis and Pig Inspection

A PRACTICAL plan for the eradication of dangerous trichinosis, at a cost of from 25 to 50 cents per pig slaughtered, was presented recently by Prof. Thurlow C Nelson, of Rutgers University, before a meeting of the American Association for the Advancement of Science. The plan depends, according to *Science Service*, on widespread use of a new, simple skin test for trichinosis developed by Drs G W Bachman, D L Augustine, and Hans Theiler It has been used successfully by the New York City Health Department during the past 18 months

"Every seventh to tenth garbage-fed pig slaughtered in this country today is wormy, infected with the most dangerous worm known to man" Prof Nelson declared.

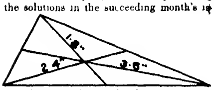
Humans eating the meat of such animals, unless it is thoroughly cooked, may develop the serious and often fatal malady, trichinosis. Federal health service estimates show that the trichinosis problem involves some 17,000,000 people, several

hundred thousand of them suffering the disease, and probably several thousand dying from it every year.

By Prof Nelson's plan the new skin test would be made on every hog slaughtered, both in commercial packing houses and on farms slaughtering for home and local consumption The cost of this, once arrangements are made, need not be more than 50 cents per animal, and may be as low as 25 cents The New York experience with the test shows it is accurate to within less than 3 percent, and the error is in the direction of safety since, with one exception, all the mistakes made were diagnoses of trichina infection where it did not exist.

Problem: The Medians

HERE is another of Lieutenant Commander Kaplan's little problems such as we have been offering our readers for several months past, each time publishing the solutions in the succeeding month's issue

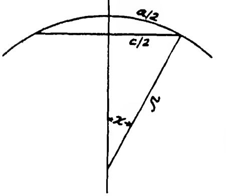


Construct by graphical means the triangle whose medians are 1 8", 2 4" and 3 6" Compute the lengths of the three sides of the triangle so constructed

That ought to be easy Send your answers or any letters about the problem to Lieutenant-Commander Leonard Kaplan, in care of Scientific American, 24 West 40th St, New York, N Y and they will be forwarded, unopened, to him

Solution to the Problem of the Chord and Arc

LIEUTENANT-COMMANDER Kaplan's problem last month read as follows Find the radius r of the circle in which a 24' chord subtends a 25' arc Also, if that



seemed pretty elementary, try taking the following sequel to it in high gear Deduce a series which defines the radius r *explicitly* in terms of the chord c and the arc a—a series, that is which will permit numerical computation of r by direct substitution of the known values of c and a

How much real trouble one man can start with just a few little words! Well, here are the solutions

The conditions of the problem are expressed by the following equations

$$2r\sin x = c \qquad (1)$$

$$2rx = a \qquad (2)$$

Dividing (1) by (2), we have

$$\frac{\sin x}{x} = \frac{c}{a} = \frac{24}{25} = .96000 \qquad (3)$$

The value of x which satisfies this equation may be shown to lie between .492 and .493 radians An interpolation may be made for the next two figures to obtain five place accuracy, as shown in the table below

x (radians)	sin x	$\frac{\sin x}{x}$	
.492	.47239	.96014	
.49288	$\frac{14}{16}$ x .00100 =	.00088	.96000
.493	.47327	.95998	

Substituting this value of x back in equation (2) gives

$$r = \frac{a}{2x} = \frac{25}{2(.49288)} = 25.361 \text{ ft (ans)}$$

To evaluate r without the use of trigonometric tables, $\sin x$ in equation (3) is replaced by its series equivalent,

$$\sin x = x - \frac{x^3}{3!} + \frac{x^5}{5!} - \frac{x^7}{7!} + \frac{x^9}{9!} \qquad (4)$$

yielding

$$\frac{c}{a} = 1 - \frac{x^2}{3!} + \frac{x^4}{5!} - \frac{x^6}{7!} + \frac{x^8}{9!} \qquad (5)$$

Rewriting (5) and using the new variable z to denote the left hand side of the equation,

$$z = 6\left(1 - \frac{c}{a}\right) = x^2 - \frac{x^4}{20} + \frac{x^6}{840} - \frac{x^8}{60{,}480} \qquad (5)'$$

The series shown in (5)' may be reversed*—made explicit in x instead of z—by setting

$$x = z^{\frac{1}{2}} + Az^{\frac{3}{2}} + Bz^{\frac{5}{2}} + Cz^{\frac{7}{2}} \qquad (6)$$

then substituting this value for x in (5)', and placing the coefficients of the different powers of z separately equal to zero, thereby obtaining the values of A, B, and C The series thus reversed will be found to be

$$x = z^{\frac{1}{2}} + \frac{z^{\frac{3}{2}}}{40} + \frac{107z^{\frac{5}{2}}}{67{,}200} + \frac{3197z^{\frac{7}{2}}}{21{,}192{,}000} \qquad (7)$$

To get a series which expresses r directly instead of x, the value of the latter as given in (7) is substituted back in equation (2). The capsizing of the series required by this operation may be accomplished by ordinary division. The resultant series is

$$r = \frac{a}{2\sqrt{z}}\left(1 - \frac{z}{40} - \frac{13z^2}{13{,}440} - \frac{1649z^3}{24{,}192{,}000}\right) \qquad (8)$$

where, as already indicated in (5)' above,

$$z = 6\left(1 - \frac{c}{a}\right)$$

For the specific values given in the problem,

$$z = 6\left(1 - \frac{24}{25}\right) = .24$$

and

$$r = \frac{25}{2\sqrt{.24}}\left(1 - \frac{.24}{40} - \frac{13(.24)^2}{13{,}440} - \frac{1649(.24)^3}{24{,}192{,}000}\right) = 25.3610 \text{ ft.}$$

*See Horatio N Robinson's "New University Algebra"—1867—Ivison, Phinney, Blakeman & Co—p 328 et seq

YOUR FIREARMS

Conducted by A. D. RATHBONE, IV

INTEREST IN FIREARMS *is traditional with American men; science has so developed them that millions yearly find sport and recreation in their use Hence this monthly department presenting a wide variety of discussion regarding firearms, their handling, and their accessories. Suggestions from readers will be heartily welcomed* —The Editor.

Exhibits of Old Guns

ATTENTION, you gun collectors! There's a treat in store for those of you who live in or near St Louis, Missouri, and Seattle, Washington During the month of March The International Studio Art Corporation will exhibit a considerable number of the ancient firearms which were formerly a part of the William Randolph Hearst collection. They will be shown in St Louis at Scruggs, Vandervoort & Barney's, and in Seattle at Frederick & Nelson's These guns are well worth seeing

Gun Plant Gossip

IT was recently our pleasure to visit several of the New England small arms manufacturers and among this cordial group not only were the latch keys out, as usual, but also we were let in on a few little secrets concerning gun developments which will be disclosed later in the year One thing we can tell, however, is that the proposed "History of Colt Revolvers," by Charles Haven and Frank A. Belden, *will* be published The response to the inquiry addressed to collectors and lovers of firearms by Colt's Patent Firearms Manufacturing Company as to whether the book would be well received was so spontaneously gratifying that it was determined to proceed with publication From advance information it will indeed be a splendid volume of some 600 pages, 250 illustrations, and a 250 page appendix—one of the most complete books of its kind ever to be published

At the J Stevens Arms Company plant, Superintendent Frank T Green exhibited some interesting developments for future Stevens products, details of which we hope to be able to tell you next month. At the home of the Marlin Firearms Company, A P. Curtis, Coordinator of Production, took us through the plant and showed us

Pat Murray — bores barrels

"the works." It's too bad that every owner of a rifle, shotgun, or revolver can't have that same privilege When you begin with the raw steel and wood and follow them through each of the hundreds of operations and processes to the completed product, beautifully finished and thoroughly tested, you not only have a great deal more respect for your own firearms, but you also come out with a feeling of increased confidence in the men who make guns. The care and

Fred Sloane — trained eyes

precision which has gone into the manufacture of your favorite firearm is something which has to be observed within the four walls of a gun factory to be truly appreciated

For example, we watched Fred Sloane align a Marlin barrel Fred, it seems, had been around gun factories for a number of years before he came to Marlin in 1902, and he's one of the few men in the country who can be depended upon for the delicate and precise work necessitated in barrel alignment We asked A P Curtis how it was done, and the explanation was as simple as the job was persnickity The barrel is held up toward a specially prepared light and Fred Sloane looks through it. If the barrel isn't quite straight, there will be a shadow which only trained eyes can see. The quirk is removed by a machine process and then Sloane sights it again. This time it's clear, clean-cut, so Fred passes it on and it eventually becomes part of a Marlin gun.

Then there's Pat Murray, who started working in the Marlin plant away back in 1886, and he not only doesn't look it, but the barrels he bores from the raw tubes of steel prove that his 54 years with his present employer have made his eye keen and

his hand deft. Go where you will in American firearms manufacturing plants, you will find the Fred Sloanes and the Pat Murrays, symbolic of that precision, that care, that accuracy which has distinguished American gun making from the time of the early Revolutionary flintlock to the present day Garand rifle. In these days of international unrest it's comforting to know that we've got men in this country who can and do make some of the finest guns in the world

Sportsmen's Shows

WHEN any one of the chaotic propensities of this weird world appears to choose our particular self on which to vent its spleen, we usually find soul satisfying surcease by smashing a couple of dozen "birds" on the skeet field, wading a rippling trout stream, or, mayhap, imagining we are drawing a bead over the rifle sights on our pet peeve of the moment But through winter months this panacea is not too easy to achieve, so we say "Bless the man who thought up the idea of the sportsmen's show!

There, for one glorious week in February or March of each winter one can utterly lose oneself among the myriad of guns, fishing rods, and everything that goes along with them. We heartily recommend a visit to your local outdoor show It will sweep away the cobwebs of too much business strain and put you in tune with the open-air activities soon to be with us As this copy reaches print, New York and Chicago, between February 17 and 25, will simultaneously be admiring new gun models or longing for that 4-ounce trout rod On the heels of these exhibits will come shows in Philadelphia, February 26 to March 2, in Detroit, March 2 to 10, in South Bend, March 6 to 10, in Indianapolis, March 16 to 24, in Minneapolis, March 23 to 31, in Buffalo, March 30 to April 7, and in many other cities and towns hundreds of things to gladden the sportsman's heart will be on display

From the Mailman

R. C R asks if barrels of second hand shot gun, 1912 vintage, will withstand modern high power loads. . . *Ans:* Be careful of ancient barrels, especially twist, laminated, or Damascus Many ammunition makers now enclose slips of paper in shell boxes warning against use of heavy loads in old types of barrels.

P. R L. wants suggestions for authoritative books on firearms for beginner. . . *Ans* "American Shotgun" (Askins); "In The Gun Room" (Burrard); "The Rifle in America" (Sharpe); "Guns and Gunning" (Curtis); "The Bird, The Gun and The Dog" (Sands).

Pot-Shots

AT THINGS NEW

Books of the Moment include Dr John B. May's revised edition of "Natural History of the Birds of Eastern and Central North America," Ray Camp's "All Seasons Afield With Rod and Gun," and "Hawks in the Hand" by the brothers Frank and John Craighead. And speaking of books, if you haven't copies of the "Handbook on Shotgun Shooting" and the "Handbook on Small Bore Rifle Shooting" in your library, your bookshelf really isn't complete. Both of these inexpensive books are published by The Sporting Arms and Ammunition Manufacturers' Institute, we'll gladly tell you more about them if you're interested

Belding & Mull (Geo McG Fryberger, Successor) have published a handbook (50 cents) on reloading and handloading of ammunition for revolvers, pistols, rifles, and shotguns which provides the powder putterer, both novice and old-timer, with practical suggestions on why and how to reload, on primers, powders, bullets, ballistics, tools, tables of charges, and accessories For beginners' benefit, unduly technical phrases have been omitted, but advanced handloaders will also find much of interest

Ithaca Gun Company, in answer to field trampers' plea for a light, yet safe shot gun, has replied with Model 37 "Feather light" pump gun in 12, 16, and 20 gage at respective weights of 5¾, 6, and 6½ pounds, with every piece proof-tested at loads developing 7½ tons pressure "Featherlight" is available in any choke, has 5 shot capacity (with plug to conform to 3-shot Federal Migratory Bird Law), 2¾ inch chamber, 14 inch stock, drops of 1⅝ inches at comb and 2¾ inches at heel, full pistol grip with gripcap, hand checkered stock and fore-end, and engraved receiver.

International Research Corporation, makers of the Argus cameras, have announced a new 55mm prismatic spotting 'scope which has been acclaimed the "hot test" thing on the market. It is 14⅝ inches long, weighs 43 ounces, comes with standard magnification of 20X and offers 14mm eye relief, thus providing comfort for gunners who wear glasses Optional eye pieces of 12 8X and 26X may be had at slight extra cost and both are interchangeable with the 20X At 100 yards the Argus "Spotscope" offers a field view of 11 4 feet with the 20X, 16 5 feet with the 12 8X, 6 3 feet with the 26X. Metal caps protect both eye piece and objective lens during transportation

Harrington & Richardson Arms Company, for convenience in carrying, protection against lost pieces, speed in preparing to shoot, offers a finely balanced single barrel shotgun in two frame weights, both equipped with black walnut stock, semi beaver-tail fore-end and auto-ejector The 4½ pounder has a 22 inch barrel, is chambered for .410 and 28 gage, while heavier model, in 12, 16, 20, 28 and .410 gage, has 26-inch barrel and varies in weight from 5¾ to 6½ pounds, depending on gage. The 410 in both models takes a 3-inch shell

Redfield Gun Sight Corporation offers to "X-ring" devotees a new streamlined (no projections to catch on gun case or clothing) precision rifle target sight with 60-minute elevation adjustment, eight individual quarter-inch positions in a two-inch extension from front to rear and an 18-minute windage scale in each direction When sight radius is changed by moving sight from one position to another, correct elevation is automatically maintained Scales are shown by dark figures on polished surface in 3-minute gradations with opposite side blank for individual markings.

Conducted by JACOB DESCHIN, A.R.P.S.

Mount Your Prints

AFTER you have gone through all the steps involved in turning out a photographic print in which you take particular pride, the job will remain incomplete unless you take the final step to give it proper display in a suitable mounting. The print does not have to be as large as 11 by 14 inches nor does the mount need to be a 16 by 20 inch exhibition size. Suit the mount size to the area in which the mounted picture is to be hung. A relatively small space may require a small mount, perhaps only 11 by 15 inches, in order to allow "breathing space" all around it. For about the same reason, a small print may look right on a large mount. It is all a matter of studying the needs of the particular print you are mounting, coupled with your own personal tastes.

The simplest method of mounting prints

Figure 1

is in an album, but the mountings we have in mind are those of exhibition caliber—the type than can be hung on the walls of one's home—ranging in size from about 10 by 12 inches up to 16 by 20 inches. For the best results, it is advisable to purchase the regular mounting boards available in photographic stores in several thicknesses and, as a general rule, in the regulation 16 by 20-inch size. Some stores sell these mounting boards in smaller sizes. The most popular boards are white on one side and buff on the other, permitting a choice as the occasion arises, without having to purchase a number of boards of each color.

Pictures may be mounted on single boards

Figure 2

or between two boards, with an opening cut out in the top board to the dimensions of the print. In the first case, the white print border if any, is trimmed off and the print mounted so that it adheres firmly over its entire surface. Adhesion is effected by using rubber cement coated on both the mount and the back of the print, allowing both surfaces to dry before laying the print down, or by employing some other adhesive, such as mounting tissue.

The second method of mounting, now very much in vogue, has a good deal in its favor, although it entails a little more trouble than the first. These double mounts can either be purchased ready made or cut at

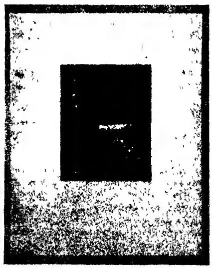


Figure 3

home. The ready-made type are provided with an opening either for 8- by 10-inch or 11- by 14-inch prints These may serve in most cases, but many workers will find it more satisfactory to cut their own for two reasons. they can cut the opening to any size they may wish without being restricted by the two sizes commercially available, and, secondly, they can vary the effect of the opening by using top boards of varying thicknesses to obtain different beveling effects

The opening is cut with a sharp knife held at an angle against a guide of some sort. This provides the attractive beveled edge. A straight edge and a knife will do the job, but in order to assure against the knife "wobbling" down its course, it is

Figure 4

necessary to lay down a sheet or two of cardboard under the mount being cut Due to the popularity of the cut out mount, two mount cutters have been introduced on the market, the Xacto and the Cut A Mat, the latter making it possible to cut circular openings (See Figure 4)

Conventionally, prints are usually placed on the mount so that the top and two sides are the same distance from the edge, leaving the space below the print about twice, more or less, the top dimension. This rule, however, cannot always be followed, as in the case of a long picture or a rather small print on a large mount In such cases, the worker's personal judgment must guide the proper placing of the print

As a general rule, the color of the printing paper dictates the color of the mount to be used For white prints use the white side of the mount, for buff or ivory, the buff side.

Figures 1, 2, and 3 illustrate the principal steps in mounting a print with a cut-out opening. Figure 2 shows the top board being set into place. The print is first centered on the bottom or base mount so that it will fit properly into the opening, and some dabs of rubber cement are applied all around the print on both mounts as well as a dab or two under the print itself. In this type of mounting, the white border need not be removed from the print because the top mounting board effectively covers it.

When the job is finished, use a block of art gum to clean marks off the surface of the mount Hang in an appropriate place either by using a gummed tab provided with a hole for hanging on a picture hook, or some such device as the Braquette adjustable picture frames

Quantity Printing

WHEN a number of prints from a single negative are desired, particularly when the prints are quite small, as when making greeting cards, it becomes a laborious and tedious job to develop the prints individually Normally, prints are exposed and dropped into the developing tray one at a time However, if care is exercised it is possible to develop three or four small prints at a time After determining the proper printing time, expose a number of prints and keep them under cover Take up three or four and immerse them in the developer solution at intervals of, say, five seconds. Thus, the second would be immersed five seconds after the first, the third five seconds later, and so on It is not too difficult a task to keep tabs on the prints and know which one went in first Besides, in a minute and half developing period, five seconds or so is not going to make much difference Also, it does not have to be five seconds, the prints can be immersed rapidly one after the other so that all three or four are in within five seconds or less If the five second interval scheme is employed the prints will be pulled out at the end of the developing time in the order in which they went in

Pre-Setting for Action

MANY photographic workers frequently experience difficulty in stopping the action of a moving object as it approaches the camera Usually the reason is that they attempt to focus the subject as it is moving This has two disadvantages you have to keep focusing up to the actual exposure, and the concentration on focusing causes you to forget the composition and pictorial interest of the subject itself In other words, you are so absorbed with the mechanics of the camera that you have no eye for the picture The better way is to set your focus in advance on some given object which the subject is due to pass When the subject

"Bumpety-Bump"

reaches this point, snap the shutter and your picture will be sharp, particularly if you have stopped the lens down somewhat to provide depth of field "Bumpety-bump" was made in this way by pre-focusing on the post When the pony reached the post, the shutter was snapped Due to the dullness caused by an overcast sky, a longer snapshot exposure was required than was necessary to stop all movement. However, the result was satisfactory

Portrait Background Shadows

PORTRAITS that include three quarters of the figure usually give considerable trouble because of the problem involved of how to balance the subject, where to put the hands, and so on Illustrated here is one way to do it A bench was used, although a box or similar object would serve as well In addition to a suitable pose and lighting, a shadow of the figure was projected on the background by means of a low-placed spotlight Observe how this shadow not only aids the composition but also imparts a certain gayety to the picture that seems entirely suitable to this particular subject.

"Ruth"

Focusing by Guess

MANY cameras are of the inexpensive type, which usually means a lack of any type of automatic focusing device, such as the range finder and reflex focusing conveniences So their owners must learn, at the very beginning of their photographic hobby career, how to estimate distances by sight. For close distances, such as those required with close-up supplementary lenses, it will doubtless be found necessary to use a measure of some kind; for work at longer distances, distance-estimation by guess must be resorted to.

Some persons get it quickly; others require considerable experience before they catch on. A standard method of learning to estimate distances is to look towards a subject a certain distance away, make a guess at the distance and then measure the distance to see how close your guess was. Another way is to look at a piece of furniture, such as a sofa or a long table and

make a guess at its length. Another is to master a basic distance estimate of say five feet and judge all distance in units of five feet. Each worker discovers some little method of his own. The fact is that most amateurs do pretty well at guess focusing, even though it is considered that medium small stops are used.

Is Chrome Alum Stable?

THIS question, propounded in *Foto Review*, and one frequently asked by amateur workers, is answered fully and authoritatively by Mr LeRoy Roselieve. The answer follows:

"Chrome alum in its dry chemical form is fairly stable and may be kept for a long time in the original container. However, short-stop baths and fixing baths containing chrome alum do not keep well as the hardening and physical properties of chrome alum break down very rapidly in solution in the presence of an acid. Hence, solutions containing chrome alum should be changed often in order to realize the full benefit of the hardening properties of chrome alum itself. Particularly stop baths used between development and fixation of negatives should be freshly mixed each time before use and discarded after treating a small quantity of film."

Candid Photography Is Still With Us

THE miniature camera started out years ago as a convenient medium for shooting pictures of people candid-wise, and it appears that the magic of the word "candid" still fills the air. A great many persons still look upon the miniature camera as a dandy way of getting pictures of people when they aren't looking. We know that today many so-called candid pictures are taken not only with the awareness but also with the co-operation of the subject, and this arrangement has, in fact, proved to be the better method in a great many cases, particularly in the matters of suitable lighting arrangement and posing.

The accompanying illustration is an example of pure candid and was shot at $f/2.8$, 1/50th of a second, during an outdoor benefit. Both subjects were absorbed in their separate tasks, the one at the easel, the other posing, so that the photographer was able to shoot without disturbing either, yet under suitable conditions, both as to lighting and pose.


"The Artist"

The Intimate Touch

WE don't know how the print "New Hampshire" will strike our readers; we are reproducing it as a bit of self-indulgence in the hope that it may strike a response in others of our readers with like interests. Why did we select this subject during a leisurely walk along a country road in New Hampshire? Well, chiefly because it was a piece of landscape removed from all the surrounding territory yet characteristic of the whole countryside. Here we had a comfortable viewing angle that, in a small, intimate space, told the whole story of the uniquely beautiful New Hampshire countryside. The lighting was delightfully right and the small cloud strategically "stopped" in the only place in the picture where it fitted best. Somehow even the size of the cloud, and its shape, are appropriate. A bigger cloud or a smaller one, or one of different shape, might have seemed out of place.


"New Hampshire"

Amidol Developer for Paper

FOR greatest transparency in heavy shadows and a rich blue black color when enlarging on bromide papers, a developer that has been the favorite of many earnest workers for years is made up from the amidol formula. One of the principal reasons why it does not enjoy the wide popularity that it deserves is its perishable nature. It does not keep and must be made up at the time of using. For those interested in trying the formula, here it is:

AMIDOL DEVELOPER

Sodium sulfite, dry	3/4 oz.
Potassium Bromide	10 grains
Water to	20 oz
then add:	
Amidol	50 grains

Develop at 65 degrees for two to three minutes.

Dust Specks On Gevaluxe Prints

As everyone probably knows, Gevaluxe prints cannot be handled as freely as prints made on other papers because of the unique surface This surface, which resembles a sort of hardened velvet, the result of an emulsion mixture which consists of finely ground rabbit fur mixed in with the gelatin and emulsion, has a way of catching lint and dust which is difficult to remove by the usual method of blowing or wiping the dust away An effective method is to use a small sable brush, bone dry Push the end of the brush against the individual bits of dust and lint until the latter have been dislodged Then simply blow the dust away It is only a matter of dislodging the dust from the surface "carpet"

Panorama Without Tripod

One of the most interesting pictures made by amateurs during the course of the New York World's Fair last year, was a panoramic shot taken without benefit of tripod or angle calibrations Mrs Dora K Howe, of the London Terrace Camera Club (New York), who made the picture, says she used the surface of a stone ledge, swinging the camera around from left to right of the Court of Nations area, halting for exposures at each turn In all, she made four exposures which, by overlapping slightly at the edges, gave her a continuous panorama of the scene with the exception of one joining, where the clouds failed to mesh This she plans to correct with pencil work

Posing Tips

Here are a few hints that will help you to determine camera position, lighting, and so on, for various types and situations

Long Face Camera should be above the head, with latter at three quarter angle

Broad Face Camera level, shooting almost profile.

Pug Nose Camera above head, nearly full front, with head bent

Long Neck Camera above head, bend head

Bald Head Camera below, front lighting, reflection from below at one side

Furrowed Face Diffused light, flat lighting

High Cheek Bones Broad front lighting

Hollow Cheeks Front, side lighting.

Full Length and Group Flat top lighting, screened toward floor

Babies Camera low, flat lighting

Hands Edgewise to camera or nearly so, shade with screen

Keeping Developer Solution

For ideal preservation of developer stock solution, it is recommended that the bottle be kept full at all times The usual method of achieving this is to have on hand a supply of marbles and drop in a sufficient number to keep the solution near the top Another method recently suggested to us by a druggist is to turn the bottle upside down The liquid seals the opening and makes it air-tight Sounds reasonable enough. The only difficulty would be in keeping the bottle upright when standing

on its narrowest end This can easily be accomplished, of course, by standing the bottle in a corner, in a box, between two standing objects, or by other means

WHAT'S NEW

In Photographic Equipment

If you are interested in any of the items described below and cannot find them in our advertising columns or at your photographic dealer, we shall be glad to tell you where you can get them Please send a stamped envelope with your request

FILMO MASTER 8 PROJECTOR Features rack and pinion tilt, whereby picture is positioned on screen by turning knob, centralized switch panel, with separate controls for lamp and motor mounted on projector base, radio interference eliminator, allowing radio music in same room during projection; lens-lock permitting projection lens to be locked in position after focusing Finished in ebony black, with chromium trim Has Bell & Howell film-protecting, side tension feature, framing device, takes 300, 400, or 500-watt lamps

NIKOR PRINT WASHER ($4 75, $7 75) Prints (and films) washed by device between leaves of vertical "book" made of specially processed absorbent fabric Prints cannot touch each other Filtering action of cloth assures clean water Rubber hose, approximately 3 feet long, attached to faucet by means of tapered connection Supporting frame made of stainless steel In use takes one third space of tray, not in use, folds flat Available in two sizes 8 by 10 inches and 11 by 14 inches Size 8 by 10 accommodates fifteen prints this size, or equivalent area of smaller prints Size 11 by 14 takes 15 prints this size, thirty 8 by 10, and so on

SUPERFLASH SUNLITE No 2 Incorporates own daylight blue color correction filter to change color temperature of light source to equivalent of bright sunlight Its use with any regular daylight color film, indoors or outdoors, without a filter, said to produce natural color reproduction with all colors in their correct relation to each other

AGFA TEXTURE SCREENS, 5 by 7 inches, $1 50 per screen or $6 for set of four, which also includes 8- by 10-inch border mask with 4½ by 6½-inch etching edge opening Size 11 by 14 inches available separately at $4 each, in sets of four $12 50 per set Border mask for latter not available

KEL GREETING CARD KIT ($1) Designed for producing greeting cards photographically Includes 12 different greetings Christmas, New Years, Valentine's Day, Birthday, and so on.

F-R HI-SPOT ($9 95) . Designed for all types of photographic lighting, especially portraiture, modeling, and natural color work Small, compact Features finger tip focusing from large to small spot; heat dissipating fins, perfect centering of filament in relation to reflector, ample ventilation on all sides, special 150 watt projection lamp rated 3200 degrees Kelvin (required for color photography) In conjunction with lamp announcement, makers add that new

booklet on photographic lighting, "Third Dimensional Portraiture — How to Get It," by John Hutchins, A R.P.S, is available on request.

Mini-Flash Flashgun ($12 50): Compact flashgun featuring folding reflector, aplanatic type. Reflector of adjustable type made of eight sections folding together, fan-like, when synchronizer not in use. Will not throw "spot" of light. Uses "fountain-pen" type flashlight batteries Synchronizer may be used on any camera Shutter-tripping and bulb-flashing mechanism entirely mechanical May be attached to camera by means of "shoe" or directly on tripod socket, connection for which is furnished with each gun.

Raygram Print Press ($1.95 to $3 95, depending on size) · Made in three sizes, 5 by 7, 8 by 10, and 11 by 14 inches Dries prints evenly, eliminates buckling of heavy weight papers, prevents blisters and uneven contraction of emulsion Made of laminated hardwood, reinforced End grain panels protected with plated strips of metal Entire unit waterproof

Kemp Adjustable Print Washer ($1.50) Designed on scientific principles for thorough print or negative washing Constantly replaces hypo-laden water drawn off from bottom Equipped with three-foot hose easily attached to faucet and held securely to bottom of sink by vacuum cup, creating gentle whirlpool action, keeping prints apart

Agfa Eveready Tripod Case ($1 75) Eveready-type carrying case for use with No 1 and 2 Agfa metal tripods Permits use of tripod without removing entirely from case Case made of selected top grain leather provided with slide fastener closing device.

Besbee Title Set ($5 50) · Letters made of new kind of plastic Will not chip, crack, or break Pressure molded into clear-cut outlines Set comes in special, grooved panel case, providing compact storage Because of thickness, letters cast striking shadow effects Can be cleaned as often as desired Set comes in white, black, or red.

F-R Cut-Film-Pack Developing Tank Reduced from $9 95 to $5 95 owing to "many new factory developments and increased facilities for manufacturing"

Super Electrophot ($14 50) Photo-electric exposure meter made entirely of American materials, including photo cell. For universal use, movies and stills, all black-and-white and color films Quick readings by finger-tip conversion for all conditions Vibration-tested before leaving factory Readings in both Weston and Scheiner ratings Enclosed in black Bakelite case, with silk carrying cord attached. Imitation morocco leather case.

Fotocraft Double Print Roller (75 cents) Double roller wipes surface of paper and eliminates air bubbles, insuring positive contact with squeegee plate. Made of sulfur free rubber, mounted on water-proof, non-shrinking wood dowels.

CAMERA ANGLES ROUND TABLE

JACOB DESCHIN, conductor of our "Camera Angles" department, will answer in these columns questions of general interest to amateur photographers. If an answer is desired by mail, enclose a stamped, addressed envelope. Queries should be specific, but Mr. Deschin cannot undertake to draw comparisons between manufactured products nor to advise on the purchase of equipment or materials.—The Editor

***Q.* I have a . . . camera and the regular . Photoflash attachment, but I have had trouble from the start with the flash equipment. I am using Wabash Press 40,000 bulbs, speeds of 1/50 and 1/100 of a second, at about *f*/5.6 and *f*/8. My pictures lack detail mostly in faces and are also lighter on one side than the other, as you can see by the enclosed pictures. What am I doing wrong? Incorrect flash lamp, time, or lens opening? My camera has a focal plane shutter. What do you advise?—A. D.**

A. From the looks of your prints, we would say that, for one thing, all of them are completely out of focus. Secondly, the bulb you are using is not recommended for focal plane shutters, you should use the No. 2, which has a longer "peak light" to allow ample time for the focal plane shutter to slide across the film while the light is at its peak. The lack of detail in the faces is due both to over-exposure and poor focusing, the uneven density of the negative is probably due to the wrong type of bulb. Use the No. 2 and if you still have this latter fault, return the camera to your dealer and have him check it.

***Q.* Out here on the desert I am constantly being "fooled" by the light, over-exposing negatives. Then I think I must be over-developing them for they are extremely dense. To illustrate: My printer has 160 watts of light within three inches of the printing frame and with average negatives I expose the paper from two to eight seconds, yet with these dense negatives I must expose them for two or three minutes before even a faint print is obtained. Is there any process by which I can reduce the density of these negatives?—C. S., Jr.**

A. For reducing over-exposed negatives, the following two formulas are generally recommended.

Permanganate Reducer

Stock Solution A

Water	32 ounces
Potassium Permanganate	1¾ ounces

Stock Solution B

Water	32 ounces
Sulfuric Acid, C.P. (add acid to water)	1 fluid ounce

For use take 1 dram (4 cc.) A, 2 drams (8 cc.) B, and 8 ounces (250 cc.) water. When negative has been reduced, place in fresh acid fixing bath for few minutes until yellow stain disappears, then wash.

Farmer's Reducer

Stock Solution A

Water	16 ounces
Potassium Ferricyanide (Red Prussiate)	1¼ ounces

Stock Solution B

Water	64 ounces
Hypo	16 ounces

When ready to use, add 1 ounce of A to 4 ounces of B, then add 32 ounces water. Pour over negative and watch progress.

For correcting over-developed negatives, the following is recommended.

Proportional Reducer

Stock Solution A

Water	32 ounces
Potassium Permanganate	4 grains
Sulfuric Acid (10% solution)	⅛ fluid ounce

Stock Solution B

Water	96 ounces
Ammonium Persulfate	3 ounces

For use, take 1 part of A to 3 parts of B. After reduction, clear in 1 percent solution sodium bisulfite. Wash thoroughly. To make 10 percent solution sulfuric acid, add 1 part acid to 9 parts water while stirring.

Before treating negatives to any type of reducer, negatives must be thoroughly washed free of hypo and if allowed to dry should be immersed in water until limp.

***Q.* Will you kindly tell me what is the approximate amount of silver on a thousand feet of 35mm film, unused?—H. A. S.**

A. About an ounce of silver is used in the emulsion on a thousand feet of this size film, the exact amount varying with the different emulsion formulas.

***Q.* I am contemplating building or purchasing an enlarger and want to use in it the lens from my camera. Would the light from the enlarger damage the lens?—C. L. H.**

A. If a normal enlarging bulb is used in the enlarger and there is provision for proper ventilation, your camera lens may safely be used in the enlarger. As a matter of fact, this is a regular practice with several well-known makes of cameras, the lenses of which are generally used interchangeably on both camera and enlarger.

OUR BOOK CORNER

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SUPERSONICS

By R W Wood, Prof Experimental Physics, Johns Hopkins University

WOOD, a noted physicist who is also part inventor and who has done much original research on supersonics, has compacted into this small volume a great deal of data on the science of inaudible sounds in their every aspect, both physical and biological. The organized bibliography at the end contains date and page reference to all the important original articles on the same fascinating subject, published in technical and scientific journals in past years (158 pages, 4¾ by 5½ inches, 42 illustrations)—$2 10 postpaid—*A G I*

HAWKS IN THE HAND

By Frank and John Craighead

BEGINNING with their youthful experiences in the capture, training, and photography of various species of hawks, owls, ravens, ospreys, falcons, and eagles, the co-authors lead the reader through a series of thrilling and interesting adventures in photography and falconry, all told with a simple, invigorating freshness (290 pages, 5½ by 8¼ inches, 57 illustrations)—$3.60 postpaid—*A D R, W*

THE VICTORY OF TELEVISION

By Philip Kerby

A RUNNING story of television developments, stripped of technical terms, that will bring the reader up to the present day, is presented in this book The author makes little attempt to explain the fundamental theories underlying television transmission and research but rather stresses television as a means of communication and entertainment Concluding chapters deal with the vital questions of who will pay for television services and what we may expect of television in the near future (120 pages, 5½ by 8 inches, a few illustrations)—$1 10 postpaid—*A P. P.*

GROWING PLANTS WITHOUT SOIL

By D R Matlin

FOR the professional grower as well as the amateur, this new volume not only gives full details of plant chemiculture but also discussions of proper plant environment, how to make cuttings, root growing substances, or hormones and auxins, budding and grafting, construction and operation of greenhouses; symptoms of plant food deficiency and excess, what to plant in various types of environment, flower, bulb, and vegetable planting calendars, insects and their control, and many other related subjects The author draws on his experience as a professor of plant chemiculture, and makes a valuable contribution to the slowly growing literature on this subject (137 pages, 5½ by 8¾ inches, illustrated)—$2 10 postpaid—*F D M*

GROWING PLANTS IN NUTRIENT SOLUTIONS

By Wayne I Turner and Victor M Henry

RATHER more technical than the volume reviewed above, this study also gives complete instructions for making the equipment and mixing the solutions for hydroponics and for growing many different kinds of plants without soil These authors, however, go into such deeper phases of the subject as the chemistry and mathematics of nutrient solutions, sources of chemicals, analysis of chemicals, technique of the nitrogen-potassium balance, fundamentals of plant physiology, and the like This volume is for the grower who is not afraid of a little chemistry or for the chemist who wishes to become a grower (154 pages, 6 by 9¼ inches, illustrations include several color plates)—$3 10 postpaid—*F D M*

DISCOVERY OF THE ELEMENTS

By Mary Elvira Weeks, Assoc. Prof. of Chem, Univ of Kansas

ONE by one the author takes up the separate chemical elements and weaves around each a tale of its history, the personalities surrounding its discovery, and factual data about the elements themselves. Yet this is no ephemeral story book but is a standard reference work for the professional or student chemist, now in its fourth edition Authentic, sound science After the discussion of each element there is a long list of references to further scientific literature (470 pages, 6 by 9¼ inches, richly illustrated)—$3 60 postpaid.—*A. G. I.*

A DIGEST OF THE BIBLE

Arranged and edited by Peter V. Ross

MILLIONS who wish they knew the main trends of the Bible never get around to reading it through, because the task seems so formidable The great length, the extensive detail, the largely obsolete English and confusing typography with its cluttered up arrangement, together provide high hurdles over which many stumble, bog down, and give up Versions nowadays available largely surmount the obstacles of obsolete language and confusing typography but leave the length at about 800,000 words, so that the reader, unless willing to make a protracted study, can scarcely see the woods for the trees, he may call for a more rapid preliminary reading facility. That is what this digest provides It is not a Bible "story" but is made up almost wholly of well selected extracts from the original language of the King James version, skilfully pieced together to make a continuous whole about one tenth the length of the original (293 pages, 6 by 9¼ inches)—$2 85 postpaid—*A. G I.*

PRACTICAL MECHANICS HANDBOOK

By F J Camm

WHILE this particular volume is prepared especially for the mechanic and engineer, it will also appeal widely to the average home craftsman who has gone a bit beyond the stage of making simple footstools and whatnot shelves Here are covered such practical subjects as blue prints and how to use them, use and care of various tools ranging from drills and files to lathe equipment, soldering of various metals, riveting, hardening and tempering, rust proofing and so on A large number of tabulations contain standard data in compact form (400 pages, 5½ by 8 inches, 379 illustrations)—$3 10 postpaid—*A P P*

MAKE YOUR OWN MOVIES

By Arthur Gale and King Pessels

OWNERS of amateur motion picture cameras, regardless of their past experience will find here a wealth of practical information on not only the various aspects of photography but also what to do before taking pictures and how to prepare the finished film for interesting projection Includes how to splice and edit, when to use filters, accessory lenses, how to prepare scenarios, how to write and photograph titles, and how to lend the professional touch to your amateur movies (230 pages, 6 by 8 inches, well illustrated)—$3 60 postpaid—*A P P.*

100 PACKAGING CASE HISTORIES

Compiled by Albert Q Maisel

MANUFACTURERS have learned in recent years that the package in which a product is wrapped and displayed for sale very often makes all the difference between success and failure of the product So conclusive has been the evidence on

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that score that serious attention has been given to large numbers of packaging problems which, when solved, have boosted the sales of many well-known products. This volume tells the story, in word and picture, of exactly 100 such cases, each case history giving data on the product, on the old and the new package, plant changes that were necessary, and sales increases achieved as a result of the improvement in the package. (223 pages, 9 by 6 inches, about 200 illustrations.)—$2.10 postpaid.—*F. D. M.*

PHOTOGRAPHY BY INFRARED

By Walter Clark, Ph.D., F.I.C., F.R.P.S.

ADVANCED amateur photographers have often expressed interest in photography by infrared but have, in the past, been at a loss as to where to find really accurate technical information that would permit them to do this type of work with a minimum of failure. Now the information is available in one compact volume, written by an authority in the field, which delves deeply into the technical aspects of the subject and gives the background which is so necessary for satisfactory work. The chapters cover such phases as general practice, darkroom practice, characteristics of materials, sensitizing for infrared, sources of infrared, applications of infrared photography, penetration through fog and haze, and so on. (397 pages, 6½ by 9½ inches, illustrated.)—$5.10 postpaid.—*A. P. P.*

WHY WORK?

By Roger Payne, A.B., LL.B.

AN analysis, and a sane one, of our wasteful economic system which renders it (apparently) necessary for us to work six days a week when, with possible organization and helped by our machines, we would get the necessary work done in one day and have the other six in which to live. The author, a graduate of Cambridge University, became a hobo, a sort of modern Diogenes, to prove that 50 days' work per year will support a man if he is willing to reduce his wants to somewhere near his needs. He also discusses ways of becoming independent of daily slavery by different kinds of specialized farming such as flower and nut growing. Wastes in human affairs occupies a large part of this book. (404 pages, 5¼ by 8 inches, one illustration.)—$2.60 postpaid.—*A. G. I.*

ALL SEASONS AFIELD WITH ROD AND GUN

By Raymond R. Camp

THE author has drawn from the experiences of a busy life spent in the woods, the fields, the streams, and on salt water, seeking and finding fishing and hunting, to produce a volume which should be the delight of every sportsman. His many years as "Rod and Gun" editor of *The New York Times* have given him the literary background and the technique to present the answers to the ever-present question of when, where, and how to hunt and fish, what equipment is actually needed and how to select it, how and where to find activity in these sports throughout the year. For novice or expert this book will be a welcome addition to the library. (352 pages, 5¾ by 9 inches, 20 half-tones, 75 line drawings.)—$3.60 postpaid.—*A.D.R., IV.*

The Editors Recommend

Best Sellers in Science

(Revised List)

1. SOILLESS GROWTH OF PLANTS—*By Carleton Ellis and Milton W. Swaney.* Complete information, popularly presented, regarding the problems and difficulties of tank farming. Formulas for chemicals and instructions for preparing tanks and other containers are given. Recommended to both experimenters and commercial growers. **$2.85**

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4. SCIENCE FOR THE WORLD OF TOMORROW—*By Gerald Wendt.* A dynamic, popular evaluation of science as a controlling force in man's destiny. Why we live as we do, and what the future has in store. **$2.85**

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TELESCOPTICS

A Monthly Department for the Amateur Telescope Maker

Conducted by ALBERT G. INGALLS

TESTED blueprints — give us tested blueprints else we perish — was the burden of several frantic letters recently received by this department from a single individual Amateur telescope makers, these letters urged, should do their work from tested blueprints. Yet tested blueprints didn't seem to be available, so something's wrong.

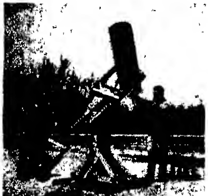

Figure 1: **Simpson's double-ender**

If amateur telescope makers were the kind who craved tested blueprints and wanted to copy some standard model, even if it might be a bit better, something really would be wrong Instead, they mainly prefer to learn the working principles of a telescope and then cook up their own concrete expression of them The result has been an almost infinite and endlessly interesting variety of telescopes, no two alike. This freedom to deviate from a set standard irks some types of men

Below are a few more of the infinite variety of telescopes, each one of which gave its maker some fun, not alone in making but in planning, and after all, isn't fun the chief commodity sought when a man decides to make a telescope?

CHIEF feature of the instrument shown in Figure 1 is the combination on one axis of an 8" $f/4.5$ Newtonian RFT, the lower telescope, for star fields, and a 12½" Cassegrainian, the upper one, for lunar and planetary observation, that is, one telescope for broad, general views and the other for restricted, particular views Incidentally, this arrangement on one axis brings both eyepieces to about the right height for comfort The maker is J F Simpson, a medical and X-ray technician, Garrison General Hospital, Gastonia, N C He states that, in place of the two forks, he believes a perhaps better mounting would be a long, heavy double yoke, with the two tubes mounted in tandem within this same simple yoke. He also plans to substitute a 12½" $f/5$ RFT for the present 8" RFT, and to add a motor drive, so that objects will not move out of the field when the user steps away to permit a visitor to look—one of the annoyances of showing the stars to the totally inexperienced.

LIKE the telescopes themselves, housings for them afford an infinite opportunity for the maker's desire for variety Figure 2 is a housing of the dome type made by Edison T Schaefer, Schulenburg, Tex The concrete pier on which the telescope rests is visible in the photograph, within the wooden fabrication which supports the floor, walls, and dome The latter has a 30" slot.

The telescope within (Figure 3) is a 10", $f/7.6$ of the Springfield type and Schaefer describes it as follows.

"It is controlled by means of three electric motors, note the switchboard (Figure 3). The declination motor is turned on by one switch and reversed by another It turns at 5000 r p m. and is geared down to 230, also two slower speeds, by means of a 500-ohm resistor and two push button switches. The R A. motor is the same as the declination motor and is hooked up to drive forward or backward at three different speeds Maximum speed, 180° in two minutes For sidereal time a third identical motor is used with rheostat control This gives sufficient accuracy for photographing the Moon"

Figure 2: **Schaefer's observatory**

IN transmitting the photograph shown in Figure 4, Raul J. Fajardo, Aguilera alta 27, Santiago de Cuba, Cuba, states that he wanted an ordinary astronomical telescope plus equipment for measuring position angles of celestial objects, determining geographical coordinates, and so on On the eyepiece end of the tube, which rotates, is a circle divided down to 5° spaces and opposite on the fixed tube is a vernier. Inside is a reticle in the eyepiece, made of threads. The whole is fairly simple and, while it splits no small hairs, it does what it was built to do.

"To illuminate the reticle a flash-lamp bulb in front of a diaphragm near the middle of the tube throws light forward, some of which is reflected back from the back face of the objective lens, resulting in a perfectly even, yellow illumination of the field of view and of the micrometer, against which the stars stand clearly (The accuracy of this telescope is not so great as to make one consider the lamp's heating effect).

"I have many times found the latitude of my town by the zenith method, also the longitude by means of the Greenwich time transmitted by radio from London In determining the latitude by the zenith method I used *B* Cassiopeia and *B* Cetus which have zenith distances about the same in my latitude For the latitude of Santiago de Cuba I found 20° 1' 15" ± 30" which is in close agreement with the latitude found years ago by a commission from U S. A I have found that my telescope can work every time within an error limit of ± 30" in latitude and ± 12s in longitude With this instrument, which costs not over $15 in all, I have been able to practice many problems of astronomy and navigation"

MORE about the Gaviola test Recently your scribe, in corresponding with Cyril G Wates, 7718 Jasper Ave, Edmonton, Alta, Canada, said he wished someone would describe the new Gaviola test, alluded to in our last two numbers, in about eleven words of one syllable or less, and here is what Wates wrote in reply, with an interlarded comment by N J Schell, 1019 Third Ave, Beaver Falls, Pa, and another by your scribe.

"In the Gaviola test, an optical surface is regarded as being built up of a large number of small surfaces, each having about 1/25 (for example) the diameter of the whole mirror A series of these small surfaces, each of which is regarded as sensibly spherical, is isolated by suitable masks (Figure 5, I), and the exact position of the center of curvature of each element is determined by a new and very accurate method.

"In the case of a truly spherical mirror, the center of curvature of all elements is situated at one and the same point — the C of C of the whole mirror (Figure 5, II), but in the case of a paraboloid (or any

Figure 3: **Schaefer and telescope**

Figure 4: Fajardo's instrument

other shaped surface), the centers of curvature of the elements do not coincide. Instead, they form a more or less irregular conic surface in space. A cross section of this spatial surface is a curved line on either side of the axis, which Gaviola calls a caustic." [The envelope, or general shape, traced out by combining or linking up parts of the several reflected rays shown in the lower part of the drawing on page 283 of "A T M" is a caustic. It looks like a big (, rather small at the top. It is true, this particular caustic happens to be made by the envelope of parallel rays reflected by a sphere but if, instead, one were to use rays from a pinhole—that is, diverging rays—

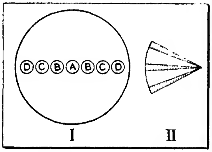

Figure 5: *In re* Gaviola test

and reflect them from the parabola in the upper part of the same drawing, one would get a caustic instead of the focus shown. The heart of Gaviola's test is that it is done along the caustic, and is therefore more nearly exact. Exactness in practice is a relative matter. Strictly speaking, our everyday assumption that our reflected rays come to foci along a straight line is not quite correct — though most of us will have to exhaust the full degree of exactness and skill contained by the old test before we venture into this more exalted realm of precision. Even if we never get there at all we shall, however, be curious to know what the test is all about, hence this little discussion.—*Ed.*]

"By the application of suitable formulas, this caustic may be reduced to a graph of the actual surface of the mirror, either with reference to a true sphere, or with reference to any one of a family of paraboloids, just as we do with the Foucault test, by placing the knife-edge at various positions, inside or outside of the mean center of curvature.

"In Figure 5, I, is the surface of a mirror with a series of small isolated elements. In the Foucault test these elements or zones are measured directly on the axis in pairs, *A*, *BB*, *CC*, *DD*, and so on. In the Gaviola test they are measured individually, but along the caustic, and their relative displacement is thus determined.

"In the Foucault test, with any non-

THE BEGINNER'S CORNER

NOT alone some beginners but some others also appear to think that the best seeing, through the telescope, will be had when the stars look brightest and sharpest to the naked eye It could be, but generally isn't. Some recorded oral comment by the widely known advanced amateur observer, Dr W H Steavenson of England, reprinted from the ever-interesting *Journal of the British Astronomical Association*, is instructive.

"The word 'seeing' should be taken as referring merely to the quality of the telescopic image Many beginners have the impression that had seeing means everything that was described by the late T W Webb as 'an impediment to distinct vision '

"I will deal first with the question of transparency, which is really quite distinct from the question of seeing Transparency is, of course, primarily of importance to those who work on faint objects in towns, on account of scattered light The inexperienced is apt to get a misleading impression of the effect of a slight increase in transparency, since an extension of 0.3 magnitude in the limit of visibility nearly doubles the number of stars to be seen

"I will now deal with the question of seeing proper, which means the definition of the telescopic image. It is often best under conditions of bad transparency There are two possible sources of disturbance, the true atmospheric conditions, due to air currents at great heights, and local disturbances low down, often in the tube of the telescope These latter are the ones which can often be avoided The best way to find out where the trouble lies is to put a bright star out of focus, racking the eyepiece out and using a high power The out-of-focus image may often be seen crossed by parallel lines or streams moving with great speed These are due to air currents at great altitude, often as high as 50,000 feet They are generally most evident just before changes of weather begin, but they are consistent with quite calm conditions at sea-level.

"At other times the focused image may be quite sharp, but it goes slowly in and out of focus All *slow* changes mean disturbances inside the telescope There are two forms of these disturbances, mirror currents, which usually are only serious with large mirrors of twelve inches or over, and tube currents Mirror currents, which consist of air currents in close contact with the surface of the mirror, show themselves in the out-of-focus image as wavy lines slowly creeping across the image in a direction at right angles to their length Tube currents are much more common, and give rise to a series of vortices in the out-of-focus image It should be noticed that any disturbance far outside the tube is generally rapid and is seen in the form of straight lines in the image It is well to remember that refractors may also show tube currents, and the fact that they are not commonly recognized is due to the fact that large instruments of this type are not generally used under the same exposed conditions as reflectors of similar aperture "

Beginners who want to go a bit deeper into these matters will find that a chapter entitled "Atmosphere, Telescope and Observer," in "Amateur Telescope Making —Advanced," companion volume to "Amateur Telescope Making," is instructive

TELESCOPTICS

(Continued from preceding page)

spherical mirror it is assumed that the C of C of any given pair of elements or zones occupies a position somewhere on the optical axis of the mirror, but this is not absolutely true, as may be seen in Figure 6, at III

"In the Foucault test, the knife-edge is made to cut the portion of the two cones of rays, common to both (shown blacked out), and the operator tries to make the shadows reach the centers of the two zones simultaneously This is made more difficult by the fact that the shadows move at different speeds

"In the Gaviola test, the knife-edge is placed at *A* and *B*, these being the points at which each separate element, *a* and *b*, appears spherical, that is, darkens evenly all over. By means of very accurate micrometers the distances $2x$ and y are measured. The fact that this must be done with an accuracy of about 1/20,000 of an inch makes the test unsuitable for most amateur workers But I have no doubt that someone will overcome this difficulty " [The test consists of measuring a lateral displacement smaller than the usual longitudinal displacement, but provides means for doing this with an accuracy 25 or more times better than was possible with the older method. Its usefulness over the older method applies particularly to mirrors of focal ratio shorter than $f/6$. Very careful construction of tester, and very rigid supports, are required. Gaviola recommends masonry supports As an indication of the values to be measured, with stationary light source, the y figure is approximately three times the familiar r^2/R, and the $2x$ figure is approximately r^3/R divided by the focal ratio Both of these are, of course, to be taken from the mean of each zone under test —*N J Schell*]

"Although the test as described can be done with the conventional knife-edge, Gaviola prefers to use a double knife edge in the form of a thin wire In his article in the November *Journal of the Optical Society of America*, he describes three methods of observing the image of this wire, with and without an eyepiece, and comments that any of these methods is more sensitive than the accuracy of any micrometer screw.

"Having measured x and y for all zones, these measurements are then applied to the formulas, and a graph drawn of the surface of the mirror, which may be done within less than 1/100 of a wavelength.

"The surfaces of the zonal elements may (and do) vary in two ways They may change their curvature, and they may tilt. These two changes cause corresponding movements in the C of C — longitudinal and transverse, as shown by the arrows in Figure 5, at IV The Gaviola test provides for accurate determination of both of these variations — the Foucault test does not.

"The beauty of the Gaviola test lies in the fact that individual judgment of shadows passes out of the picture. One is testing a series of spheres, and the sphere is the easiest surface of all to measure. Whether

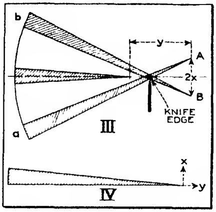

Figure 6 Concerning Gaviola test

some T.N. will develop a modification of the test suitable for amateurs who do not possess expensive micrometer apparatus, remains to be seen In measuring a 6 inch mirror (f/3), the maximum value of x is less than one tenth of an inch, which means pretty delicate technique! One of my brainwaves is the suggestion to try two plates as a condenser, in an oscillating circuit, in place of a micrometer, to measure x."

JOINING two sheets of HCF is a necessity in cases where the desired lap is wider than the standard widths (8" and 10¼") of HCF will afford, and in "ATM," p 367,

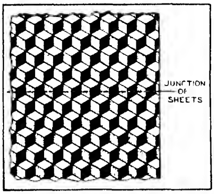

Figure 7: Marrying HCF and HCF

a method of welding these sheets edge to edge is described An alternative method which requires less of the art of l**e**rle main has been communicated by Horace H. Selby. First, he trims the two sheets back from the edge a little way, in order to get into uniform material, so that a careful crosswise match between the cells is possible Then he slides one of the pieces along the other till he has a precise lengthwise match between cells. The sheets are now ready for permanent joining. This he does with an ice pick, very hot, which he touches very lightly and quickly to the cell slopes at their respective junctions, skipping alternate slopes (the down slopes) and filling these in later by turning the sheets around and repeating the process (Figure 7). He says it takes only ten minutes to join pieces of HCF for a 15" lap.

PITTSBURGH is to be the mecca for all amateur astronomers and telescope nuts on Friday, Saturday, and Sunday, July 5-7, and there will be plenty to do and see while there. This is in addition to the annual Stellafane get-together, to be announced here later.

See our other advertisement on page 187

CURRENT BULLETIN BRIEFS

(The Editor will appreciate it if you will mention Scientific American when writing for any of the publications listed below)

STEEL SERVES THE FARMER is a lavishly illustrated bulletin that traces the development of farm equipment from early beginnings down to the present day when steel has become a highly important metal in farm implements *American Iron and Steel Institute, 350 Fifth Avenue, New York, New York — Gratis.*

A BIBLIOGRAPHY OF BIRDS is a two volume, 937-page reference work to scientific articles on the anatomy, physiology, ecology, behavior, and related aspects of ornithology, listed alphabetically by authors It is intended mainly for the investigator and it omits uncritical literature *Field Museum of Natural History, Chicago, Illinois — $6.00.*

FLEXIBLE METAL HOSE is a 38-page catalog that describes and illustrates a wide variety of flexible metal hoses and their uses in industry Included are hoses for handling saturated steam, super-heated steam, liquids of all kinds, many types of corrosive chemicals, and so on. A number of tabulations present essential data *Chicago Metal Hose Corporation, Maywood, Illinois — Gratis*

HOW TO USE THE G-E EXPOSURE METER FOR PRINTING AND ENLARGING is an illustrated circular that will enable the dark room worker to put his exposure meter to uses other than that of determining exposure when making the original negative. *General Electric Company, Schenectady, New York — Gratis.*

ANNUAL REPORT OF THE SMITHSONIAN INSTITUTION. The title connotes something exceedingly dull but the actuality is quite the reverse, because the bulk of the report is a so-called "appendix" containing 32 of the best scientific papers of the year — 470 pages of them. Many persons having scientific leaning buy these books annually, never miss one of them *Superintendent of Documents, Washington, D C — $1.50.*

THE SENTINEL ELECTRIC EYE DOOR ATTENDANT is a circular that illustrates and describes a photo electric set-up which can be used for a wide variety of purposes, from announcing store customers to acting as a burglar alarm in home or shop Prices are included *Photobell Corporation, 123 Liberty Street, New York, New York. — Gratis.*

MT-SCOPE is a 16-page illustrated brochure which describes equipment to be used for underground exploration for buried masses of metals. *Fisher Research Laboratories, 745 Emerson Street, Palo Alto, California.—Gratis.*

PLACER DREDGES is almost a reference manual on the subject of placer dredging. It not only describes mechanical and structural details of a complete line of dredges but it also contains instructions for computing sizes and outputs of dredges. Two full pages of formulas and computations will be found useful in placer mining work. A four-page insert is of historical significance, telling the story of the beginnings of placer gold dredging in the United States. Bulletin No PD-4. *Bucyrus-Erie Company, South Milwaukee, Wisconsin. — Gratis.*

SPEED FLASH MANUAL is a 34-page pocket-size booklet that describes Photoflash synchronizers and tells how to use them with various cameras and under varying operating conditions Thoroughly illustrated with drawings and photographs *The Kalart Company Incorporated, 919 Broadway, New York, New York — Gratis*

CATALOG AND DATA BOOK is a 104-page illustrated pamphlet that gives answers to everyday finishing problems, reports new developments in spray painting equipment, gives prices, provides engineering and performance data Request Catalog No 75 *Binks Manufacturing Company, 3114-40 Carroll Avenue, Chicago, Illinois —Gratis*

MANUAL OF RADIO SERVICING gives in compact form, for the radio service man, facts about service problems as encountered in modern radio sets It presents a series of ideas that will assist in trouble-shooting *Supreme Publications, 3727 West 13th Street, Chicago, Illinois — 10 cents*

AHRIMAN, A STUDY IN AIR BOMBARDMENT, by Brig Gen Oliver L Spaulding, U S Army, is a 144-page paper-covered book that presents a brief, non technical synthesis of the general subject of aerial bombardment of cities It deals lucidly with such controversial subjects as the cost of air raids and what the air raid can accomplish. Best of all, it presents plans for possible preventive action *World Peace Foundation, 40 Mount Vernon Street, Boston, Massachusetts. — 50 cents*

RAILROADS CAN DO THE JOB is a folded leaflet that demonstrates graphically and in text that railroads can meet present and prospective needs for transportation and can do a better job than any competing form of transportation *Association of American Railroads, Transportation Building, Washington, D. C. — Gratis.*

THE SPERRY GYRO-HORIZON AND THE DIRECTIONAL GYRO is a 24-page booklet that describes in some detail these two instruments which are of tremendous assitance to the airplane pilot. *Sperry Gyroscope Company, Incorporated, Manhattan Bridge Plaza, Brooklyn, New York. — Limited Free Distribution.*

COLOR PHOTOGRAPHY is an illustrated pamphlet that describes the operation of the Lerochrome One-Shot Camera Several drawings illustrate the principle of color photography as well as the operation of this particular camera Prices are given. *National Photocolor Corporation, 480 Lexington Avenue, New York, New York. — Gratis.*

ANNUAL BULLETIN OF THE TEXAS ARCHEOLOGICAL AND PALEONTOLOGICAL SOCIETY, for 1939, is a 271-page book with 55 plates, containing nine articles on archeological finds, mainly in the Texas region. *Dr. Otto O. Watts, Hardin-Simmons University, Abilene, Texas. — $3.00.*

LEGAL HIGH-LIGHTS

Patent, Trade Mark, and Related Legal Proceedings That May Have a Direct Effect on Your Business

By ORSON D. MUNN, Litt.B., L.L.B., Sc.D.

New York Bar
Editor, Scientific American

VARICOLORED

THE owners of the trade marks "White Horse" and "Black Horse" for Scotch whisky successfully opposed an attempt by another to register the trade mark "Red Horse" for use on cordials, brandies, rums, cocktails, and similar alcoholic beverages In the case in question the owners of the trade mark "Red Horse" for alcoholic beverages attempted to register it in the United States Patent Office The owner of the trade marks "White Horse" and "Black Horse" opposed the registration on the grounds that the trade marks were confusingly similar to each other The Patent Office decided that the marks were confusingly similar to each other and sustained the opposition On appeal to the Court of Customs and Patent Appeals, the Court pointed out that if the appellant were permitted to register the trade mark "Red Horse," other producers of alcoholic beverages might attempt to register the trade marks "Brown Horse," "Gray Horse," "Sorrel Horse," and "Bay Horse" and concluded with the following

"That the use and registration of such marks on alcoholic beverages would destroy the value of appellee's registered marks, is so apparent as to require no discussion."

HAM AND EGGS

A SUIT of more than usual interest involving the so-called "Ham and Egg Pension Plan" was recently filed in the Federal Court in California

The suit charged copyright infringement and was brought by the proprietor of a copyright for a book against tho Secretary of State of California The copyrighted book described an old age pension system similar to the pension system submitted to the voters of California last November and popularly known as the "Ham and Egg Pension System" The purpose of the suit was to restrain the Secretary of State from distributing to the voters of the state, as required by California law, the proposed constitutional amendment providing for the pension plan A motion was made on behalf of the Secretary of State to dismiss the suit and during the course of its consideration of the motion, the court pointed out that a copyright for a book did not protect ideas described in the book but merely the language describing the ideas Since the copyrighted book described a pension system to be operated by the Government, a governmental unit could operate such a system without infringing the copyright. The court then concluded that to operate such a system it was necessary to adopt suitable legislation putting it into effect and the publication of such legislation did not constitute copyright infringement In this connection the court stated that "a plan or system advanced for government adoption cannot be copyrighted so as to prevent the publication of that plan or system, whatever the medium of expression used, in the form of a proposed law incident to its submission to the vote of the electorate."

As a result of its conclusion the court dismissed the suit.

VITAMIN C

A RECENT attempt to obtain a patent on Vitamin C, the anti-scorbutic factor, met with failure An application was filed for a patent on hexuronic acid, a white crystalline solid identified as Vitamin C The application was rejected by the Patent Office on the grounds that hexuronic acid had previously been isolated from the adrenal glands of animals and had been described in a printed publication published some years ago prior to the filing of the patent application The applicants for the patent conceded that hexuronic acid had been isolated from adrenal glands and had been described in the publication, but pointed out that the previous discoverer did not appreciate that hexuronic acid was the same substance as Vitamin C but merely referred to it as a "reducing factor" The Patent Office, however, rejected the application, pointing out that the substance itself was not new and that a patent could not be obtained for the discovery of a property or characteristic of a substance nor for the discovery of the actual identity of a substance

Upon appeal to the Court of Customs and Patent Appeals the Court affirmed the rejection of the Patent Office stating "We have hereinbefore concluded that ordinarily no invention exists in the discovery of a property possessed by an old substance . . ."

SECRETS

WHERE secret formulas become involved in litigation the court will attempt to preserve the formulas from publication. This is illustrated by a suit involving a secret formula for an alloy used in the manufacture of flat-ware and hollow-ware. The suit involved two manufacturers, each claiming to be the exclusive licensee of the owner of the formula. One of the defenses raised was that the formula was no longer secret but was fully described in a printed publication. If this were true the formula of course would be public property and neither party could restrain the other party from using it.

In order to determine whether the published formula was the same as the secret formula it was necessary to take testimony as to the nature of the secret formula and if the testimony were taken in the usual manner the information as to the nature of the formula would be available to the public and the secret character of the formula would be destroyed. To protect the owner of the formula against this contingency the court ordered that the testimony should be taken in camera and should be then sealed and submitted to the court, stating

"Having in mind that the taking of evidence upon the question whether the published formula is the true formula, and whether if so its dedication to the public is a dedication of the process, may threaten exposure of both formula and process if they be still secret, evidence may be taken in camera and sealed as was done in A O Smith Corp v Petroleum Iron Works Co."

MANUFACTURE

THE manufacturing of an infringing article even though the article is never sold or placed into actual use, constitutes patent infringement This question was considered in a recent case involving patents for tractors It was contended by one of the parties that the court did not have jurisdiction over the suit because a tractor charged to infringe one or more of the patents had not been sold or used The Court pointed out that this contention was without merit because, if the tractor infringed the patents, the mere manufacture of the device constituted patent infringement In this connection it would be well to note, however, that the failure to use or sell an infringing device would affect the amount of damages In the absence of sale or use of an infringing device it would be difficult to show that the patentee had suffered any damages or that the infringer had realized any profits

MERCILESS

AS pointed out in a recent federal court decision, the nature of a patent is such "that joint owners in it are at the mercy of each other" In the suit in question a patent for an electric fan was jointly owned by two persons One of the joint owners filed suit against a manufacturer of electric fans charging infringement of the patent and the other joint owner refused to join in the suit To meet this situation the first joint owner joined the other joint owner as a defendant in the suit The manufacturer of electric fans made a motion to dismiss the suit on the grounds that joint owners of a patent must join in the suit as plaintiffs The Court first considered the peculiar nature of patent rights, pointing out that where a patent is jointly owned either co-owner may manufacture, use, and sell the patented invention without the consent of the other co-owner and without liability to account for any profits realized from the invention The Court also pointed out that one joint owner may grant a license to another person without the consent of the other co-owner and may collect for his own use the royalties arising from the license.

The Court concluded that to maintain a suit for patent infringement both co-owners must voluntarily join in the suit and that if either co-owner refuses to do so he can not be joined as a party defendant.

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NINETY-SIXTH YEAR • ORSON D. MUNN, Editor

CONTENTS • APRIL • 1940

BUSINESS executives are taking more and more to the airways, in private planes, in order to keep in personal touch with activities within widely spread organizations. A well-designed example of planes that are being so used is the Spartan Executive type illustrated on our front cover. This particular ship is used by the Halliburton Oil Well Cementing Company to fly executives to oil-field jobs all over the country.

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Personalities in Industry

THOMAS H. CHILTON

WHEN Thomas H. Chilton, director of the du Pont Company's Technical Division, Engineering Department, was awarded the Charles Frederick Chandler Medal several months ago by Columbia University, he was cited "for his outstanding achievements in the discovery and formulation of principles underlying the unit operations of chemical engineering, and in the application of these principles to process development, to equipment design, and to chemical plant construction and operation"

Honors came to "Tom" Chilton early in life. As an engineering student in Columbia he received the Illig Medal for "commendable proficiency in the regular studies" He is a member of Tau Beta Pi, Sigma Xi, and Phi Lambda Upsilon His portrait in the Engineering Alumni room at Columbia bears the designation "Leader in Fundamental Research"

Mr Chilton was born in Greensboro, Alabama, August 14, 1899. He attended Starke's University School in Montgomery, and graduated from the Lanier High School in 1915. His college career began in the University of Alabama, which he attended one year as a student of chemical engineering. Then came his transfer to Columbia University, which he attended five years. He graduated in 1922 with the degree of Chemical Engineer In 1918 Mr Chilton was enrolled in the Columbia University unit of the Student Naval Training Corps

While a student in Columbia, Mr Chilton served two years as assistant in the Department of Chemistry and one year in the Department of Mechanics He still serves Columbia as Lecturer in Chemical Engineering Extension and as a member of the advisory committee for the Chemical Engineering Department. He also serves Johns Hopkins University in a similar advisory capacity

Following several years' association with F J. Carman, on chemical research in New York City, Mr. Chilton joined the du Pont Company in 1925. Here Mr. Chilton was first assigned to the development of the pressure process for the oxidation of ammonia for the production of nitric acid, and he carried on this work during the period from 1925 to 28. He was also engaged in the installation of ammonia oxidation units for the supply of nitre for chamber sulfuric acid plants. In 1928-29, he was engaged upon studies on the improvement of the contact sulfuric acid process

In 1929, Dr C M. A Stine, then Director of the Chemical Department, authorized, as part of the fundamental research program of the du Pont Company, studies in chemical engineering, and a group of engineers was assembled for the purpose. Initially under the supervision of Dr John H. Perry, the direction of the group was assigned to Mr. Chilton before the end of that year The group was gradually enlarged, and in 1935 it was consolidated with a partly parallel group organized in the Engineering Department in 1932, under Henry B du Pont, as Head of the Technical Division. Mr. Chilton was named as assistant division head, and in 1938 succeeded Mr du Pont as division head.

The objectives of the group are the development of widely applicable design data for chemical process equipment Studies have been made on fluid flow, heat transfer, crystallization, absorption distillation, adsorption, drying, extraction, filtration, agitation, and other unit operations.

Mr Chilton served as a director of the American Institute of Chemical Engineers for three years and is Chairman of their Committee on Papers. He is active in the American Chemical Society as a member of the editorial board of the Technologic Monographs.

Despite his many interests in industry, education, and in scientific and fraternal societies, Mr Chilton always has time for his associates and friends He confides, reluctantly, that he has one hobby, that of collecting automobile registration plates of the various states. However, those who know Tom best believe his real hobby is chemical engineering.

50 Years Ago in . . .

Scientific American

(Condensed From Issues of April, 1890)

ROADS—"Prof. Ely, of John Hopkins University, estimates that poor roads cost the farmer, on an average, $15 per horse, and Prof Jenks, of Knox College, Illinois, argues that with good permanent roads freight could often be hauled ten miles on wagons cheaper than it could be taken one mile on a dirt road to a railroad station, unloaded, put on the cars, and carried to its destination"

"MOUNTAINS OF THE MOON"—"The geographical discoveries made by Mr. H M Stanley's expedition in its route, accompanied by Emin Pasha, to the south of Lake Albert Nyanza (sic) and west of Victoria Nyanza, through a region previously unexplored, are the latest additions to our knowledge of the wonderful interior of what has been called the 'Dark Continent' He . . describes the Ruwenzori range of mountains, rising above the Semliki valley and he considers them identical with what the ancients called

'The Mountains of the Moon' The scenery afforded by these mountains, as one passes by their feet, is most splendid Deep valleys of an intense darkness run up from the forest beneath A distinguishing feature of the range is the clear and well defined character of the hill tops Almost invariably on the southern side these are of a conical shape, with extremely steep slopes, some of them being quite 45 deg in steepness In some places the ravines down which streams flow are quite 6000 or 7000 feet deep The height of the highest point of the range is about 17,000 feet, with about 2000 feet above the snow line"

RABBITS—"A good deal of interest is being centered in the colossal efforts made by the Victorian government for the suppression of the rabbit pest in that colony In upward of 100 shires in the northern and western districts of the colony simultaneous action is to be taken for the destruction of the rabbits, in accordance with the Rabbit Suppression Act, recently adopted by the Legislature Poisoned grain is to be largely used, and it is estimated that fully 75 per cent of the rabbits will be killed"

AT NIGHT "At a recent test of search lights for the purpose of discovering an approaching enemy dressed in uniforms of various colors, it was found that the red uniforms were very distinct, blue being the least conspicuous"

BLIND—"Rev W. H Murray, a missionary at Peking, has devised a system for teaching the blind, and has reduced the Chinese language to 408 syllables By this system the blind have been enabled to learn to read with marvelous facility The blind themselves are employed in the stereotyping and printing of books, which are produced at an amazingly low rate, compared with books embossed for the blind in this country Among the Chinese the blind are regarded with great consideration, and they are watched with intense interest when they read with their fingers from the books which they carry in their hands"

FLOOD CONTROL "Recent tourists in China announce that Chinese statesmen have entirely risen above superstition, and that the Chinese merchants speak contemptuously of the efforts of the priests to prevent the calamity of floods, saying, 'Chinaman, he all time chin chin' (meaning that they resort to prayers and other priestly methods in time of calamity), 'while Melican man he build more stout walls to keep water back'"

LIGHT—"The light of the firefly is not a vital, but a chemical process It seems that chemistry should find means to imitate this process, giving us a form of combustion wherein the energy of fuel is all converted into light instead of being mostly wasted in heat'

RAILROAD SIGNALS—"The block system of running railroad trains has recently been introduced upon the Central Railroad of New Jersey, between Jersey City and Bergen Point It is a four track road, and is traversed by a very large number of trains daily It has been found advisable to protect all classes of traffic and accordingly the system has been put in operation on the four tracks The signals are semaphores, and are arranged one above the other for a single line of track The upper semaphore has a square end, the lower semaphore is fish tailed in shape When the upper one projects at right angles from the post, it indicates that a train is on the next block Whenever it projects in this way, the lower one is also set at danger or caution As the train leaves the block thus protected the upper signal falls, but the fish-tail signal remains at caution until the next block is passed and the train is two blocks distant"

BILLS—"All of the bank note currency of the Italian government is engraved and printed in the United States"

TWENTY MULES?—"There are five teams engaged in hauling borax from the works in Saline Valley to the railroad In this newly discovered borax field lies the greatest natural deposit of borax now known to exist in any part of the world It is only necessary to dig up the mineral and shovel it into wagons"

AND NOW FOR THE FUTURE

¶ What is the place of blimps in modern warfare? By Brockholst Livingston.

¶ Archeological discoveries in an Anglo-Saxon treasure ship By J. Reid Moir, F.R.S.

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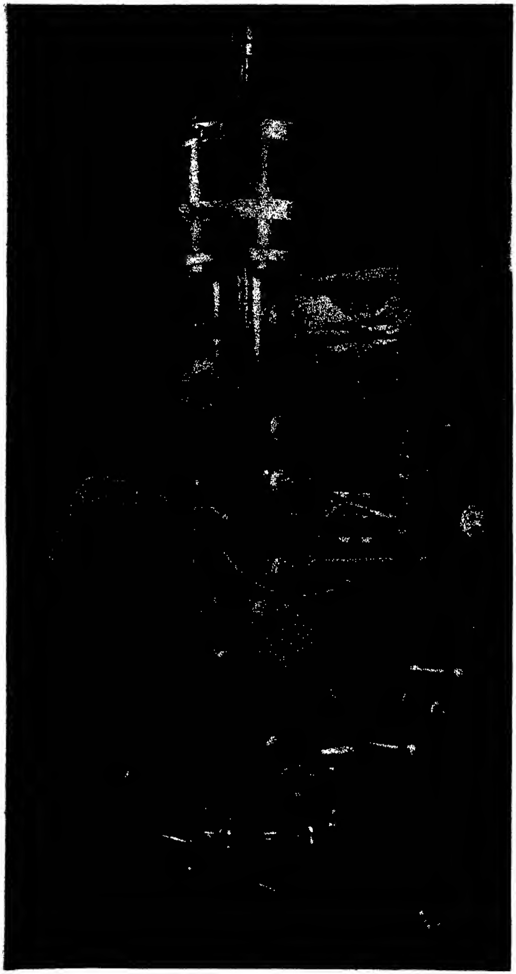


AIR CONTROL SOLVES TUBE PROBLEM

CATHODE - RAY tubes, widely used in research laboratories and industrial applications, are sometimes temperamental The reduced air pressure within them must be exactly right or they will not operate satisfactorily This factor has been overcome by mechanical methods in the past, but only with partial satisfaction. When Westinghouse engineers were working on a new cathode-ray oscillograph (shown at left) for use in the new high-voltage laboratory of the Bureau of Standards, they incorporated in it a small bellows by means of which the number of air molecules within the tube could be accurately controlled, thus doing away with the formerly used mechanical devices. The new oscillograph will be used to measure high voltages in research on the effectiveness of electrical insulation and lightning arresters.

Every bunch of bananas is dunked at the shipping point to destroy all clinging pests such as insects

Green Dragon of the Tropics

Banana Fungus, Picturesquely Named by Natives, Threatened Extinction of Industry . . . Menace Averted . . . Enormous Cost, Ingenuity Involved

By CHARLES MORROW WILSON

THANKS to Hollywood, most of us think of bananas as the easy manna of the drowsy tropics. A recent movie depicted the hero lounging around the tropics and reaching up to pluck mellow, ripe fruit from the trees In real life and in real tropics, bananas don't ripen edibly on the plant They have to be cut green and left to ripen in the shade If they ripen on the plant the pods split and the pulp sours.

Indeed the banana is one of the most delicate and scrupulously cultivated crops on earth. Every stage requires hard work and tender care. The banana also requires perpetual haste, an average initial investment of about $400 per banana acre, and more man-hours of labor than any other principal harvest of the modern world.

In bananas, every dime must be earned with hard work, salty sweat, and fast motion. That is why the banana-growing republics of Guatemala, Honduras, Costa Rica, and Panama are becoming elysiums of employment, why banana-growing centers frequently have more jobs than men to fill them. Machines are said to rob men of jobs. The banana industry flatly denies this. During the past ten years the tonnage of banana machinery has been almost doubled So has the number of banana jobs Every two acres of the crop now means a year-around job, and approximately every five tons of new banana machinery seems to create a new banana job.

AND to the normal hazards of flood, drought, and hurricane there has been added of late a further and more terrifying threat to this 300,000,000-dollar-per-year industry· the sinister disease known as Sigatoka. A leaf-killing fungus spread by a wind-blown spore, this disease has played havoc in vast sections of the republics to the south, threatening to obliterate the entire banana crop there as it has already done in the South Seas

It is no longer enough that banana men work for a living. Now they have to fight for it—not with firearms or revolutions, but with spray guns, dust-throwing airplanes, and spray-squirting tractors Banana-land's new war is a fight to the death against this mysterious leaf-killing fungus, scientifically known as *Cercospora musae zimm*

Sigatoka takes its common name from the region where it first appeared—the banana-growing center of the Fiji Islands. Until the disease struck there, that region was one of the great banana-growing areas of the world The tiny

Using the pipe-line type of spray against the fungus Sigatoka in Honduras. The pipe-line "grid", with hose connections, runs all over a plantation

round spores of Sigatoka settle upon the broad lush banana leaves, and within two or three weeks multiply to form gray-brown "death-spots" These spread and grow until the leaf-structure of the plant is twisted and parched as though burned by fire The fungus doesn't impair the food value of the fruit, but by killing the leaf surfaces it causes the fruit to ripen prematurely Hence banana traders would buy green-cut fruit which looked all right They would load it aboard ships and entire banana cargoes would ripen prematurely in mid ocean and rot before they reached port

The method by which the disease spread was as insidious as its effects Borne by the wind, it swept on at altitudes from sea level to 14,000 feet in the wettest jungles and driest deserts One crew of alarmed pathologists took to the air At 5000 feet they held out glucose coated slides and caught live Sigatoka spores on the glass

NO wonder the disease has circled the globe By 1922 it had crippled banana production in Australia and New Zealand swept into South China Siam Malaysia, and various South Sea islands and cut westward to India, the Canary Islands and the Guinea coast of Africa In 1935, Sigatoka blew into the western tropics In 1936, the mysterious fungus began to invade tropical mainlands striking first in the renowned Ulua basin of Honduras Within a year, about 80 percent, or some 32,000 acres of the champion Honduran crop was reported infested and the "Green Dragon," as the natives call the disease, was charging forward into Cuba, Jamaica, and other West Indian islands.

Obviously something had to be done Sigatoka was threatening the life of the American banana industry with its more than a half billion dollars of United States capital We can't raise bananas commercially in the United States But we eat about 10 billion bananas a year Their caloric value is high, we absorb from them 460 calories per pound (peeled) and more vitamins than from any domestic fruit, berry, or melon The banana has, therefore been called the poor man's food fruit Current medical literature stresses bananas as infant food, a counter-actant for constipation and as a hospital standby for the aged and infirm A widespread shortage of bananas would seriously affect our national diet

As the Sigatoka menace grew, it began to threaten international trade as well For the banana is the one great American crop whose export volume is steadily growing War-infested England and Europe still import nearly 40 million bunches a year. Western bananas have "taken over" English markets, made rapid inroads into continental Europe and Scandinavia and reached the markets of Spitzbergen, 300 miles north of the Arctic Circle Hitler lists American-grown bananas as "indispensable food" and, until the outbreak of the present war, had bartered for import of more than 15 million stems per year Last year watched the first shipload of Colombian bananas leave for Soviet Russia. Three weeks later, I read dispatches stating that a "novel delicacy called bananas" were being sold in Moscow at 35 cents apiece—thus yielding the U. S S. R. a net profit of about 1500 percent! United States dealers have no such lofty ideals of profits for they gladly take a net profit on bananas of 1 to 5 percent.

But it is in South America that the banana is most needed The lives of five republics down there depend upon bananas, which are their surest tax source the basis of a 50 million-dollar-a-year cash payroll, the sustainer of at least 125 ocean ships and about 2500 miles of necessary railroads In Central America bananas build roads, bridges, and drainage systems From Guatemala through Colombia, more than 400 common schools are maintained by banana planters and companies United Fruit, alone maintains 11 base hospitals from Cuba to Colombia, which give medical services and hospitalization to more than 200,000 patients each year Malaria, scourge of the tropics, has been pretty well beaten back from the American banana front

Tractor-drawn spray tank. Many nozzles shoot the liquid fungicide in all directions

Without bananas, it would probably come back and this largest battlefront against tropical disease would tumble

Green bananas are a basic food in the tropics Fed to livestock, they are grass and grain together, since the starch and minerals of unripe bananas are like those of grain Plantains, or cooking bananas, are a staple fare for people Green bananas they mash into dough for pan bread or they bake or fry them

Moreover, the banana industry has hoisted tropical wage levels and banished peonage as it changed thousands of native workers, schooled only in use of the machete, to skilled workers who now qualify for more than 200 trades

These newly skilled workers, many of whom earn as much in a day as their fathers earned in a week, couldn't be expected to return willingly to dried beans and jungle joblessness If neglected, the spore of Sigatoka could very easily become the spore of Pan-American chaos

But Sigatoka is not being neglected Four years ago when the roundspore fungus made its dumbfounding appearance, native witch doctors arose vaporously to peddle alleged cures, including mysterious liquids to be injected with a hypodermic needle into banana stems Some planters chopped down their banana fields in the vain hope that the ruining spores would not come again Others pooh-poohed the menace and struggled to keep on with old routines United Fruit, which owns and operates about 110,000 acres of banana lands, armored itself with a huge catalog of fungicides and set out as corporate knight to slay the ruinous Green Monster

After four years of dramatic but bloodless jousting, Sigatoka is by way of being licked, but not without colossal work head aches and expense

EARLY experiments proved that copper derivatives check the spread of the fungus The chief task was to devise a practical means for getting a spray to stick to the leafy plant in heavy rainfall climates United Fruit staged a ten-nation brain storm in which engineers, scientists, accountants, and fruit cutters turned inventors overnight The new principle of the griddle-type pipeline spray came into being Banana fields are grouped into spray units of 600 to 1200 acres For each unit must be built a central pumping and mixing plant, equipped with a reservoir and a block of Diesel-driven pumps, which mix the spray and force it into the pipelines at high pressures. The pipelines are equipped with hose cocks at convenient intervals of from 120 to 200 feet Actual spraying is done with garden-type hoses topped with high-pressure "nozzle guns" which break the liquid spray into fine mist and hurl it over the entire leaf surface of the giant plants Permanent spray equipment requires a thousand or more pounds of metal pipe per acre.

In addition to this permanent installation, two-man spray crews make the rounds of banana fields at intervals of 10, 15, or 30 days, depending upon the virulence of Sigatoka, spraying every plant with Bordeaux mixture which consists of five pounds each of copper sulfate and hydrated lime to each 50 gallons of water The men cover about five acres per day between dawn and noon, the preferred tropical working hours A commanding majority of all banana growers throughout the American tropics are becoming "spray conscious" Tractor sprays are taking to dryland banana fields of Jamaica and Colombia Small growers on banana outskirts are fighting the Green Dragon with squirt guns and back-pack sprayers

At present, about 90,000 acres of United Fruit Company lands are under spray, and the acreage is rapidly being extended Before the ground-spray net works were completed. the company opened Sigatoka warfare in the air, using a squadron of especially built dusting planes which set a world record by dusting 208,000 acres with 8200 tons of lime-sulfur powder in 2152 flying hours without a fatality or major crackup

However, plane dusting is less effective than liquid spray and is gradually being discontinued Meanwhile Sigatoka mysteries remain It appears, for example, that the roundspore does not seriously molest banana plants which grow in shade Nobody can explain this But coffee-banana farmers, particularly of highland Guatemala, are taking advantage of it to grow bananas under shade trees used to shelter the delicate coffee bush Unfortunately, shade impairs banana yields.

But Sigatoka defenses are holding In sprayed fields, banana leaves no longer writhe and twist with coalescing death spots New style banana plantings are being "put under spray" at overhead costs too great to allow the former practice of carefree abandonment to the omnipotent jungle Nowadays profitable bananas must stay in bearing from 10 to 25 years, instead of five years which was once the average bearing period

Banana planters continue to clear jungles, moving plantings farther and farther inland to tap new, rich, frontier

Conveyors carry bananas aboard ship and into the hold, *above* and *at left*. Since bananas must be handled with tender care, each bunch rests in a flexible canvas pocket

Part of the extensive mechanization of a banana plantation in the war against Sigatoka: a modern type of pumping station for banana spraying. *Below:* Like gigantic lawn sprayers, water-rotated nozzles throw firemen's streams over the banana plants. Each nozzle covers more than three acres and supplies two inches of "rainfall" every 24 hours for irrigation

All photographs by the author

soils In Guatemala, Costa Rica, and Panama, new banana operations are crossing the high backbone of mountains New banana railways crowd through primeval wilderness.

From Mexico to the Guianas, Sigatoka further speeds the banana tempo and motivates more and more investment and invention. One of the newest of these is banana irrigation, the most elaborate known to any big-scale agriculture The newest style banana irrigation, introduced in Honduras and Guatemala, consists of linked series of 25-foot metal

To prevent dropping bunches during harvesting, plant trunk is cut

towers fed by giant Diesel-powered pumps Each tower is topped by a water rotated nozzle which throws a fire-hydrant spray over three and a third acres of planting for the equivalent of two inches of rainfall every 24 hours

Cultivation and harvest methods are correspondingly improved, another important reason why the tropical Americas have become the commercial banana sources of the world, even though the real homeland of the fruit is India, 14,000 miles away, and even though the name "banana" is a dialectic from the Guinea coast of Africa

IT'S an ill wind that blows no good Ill winds carrying Sigatoka spores continue to blow damage and ruin to outlying and unprotected banana lands But the principal crop is being saved—and the fight against the disease has brought its benefits Banana employment has increased between 25 and 40 percent, and the increase continues Better cultivation, irrigation, and fertilizing necessitated by high costs of Sigatoka fighting have raised commercial yields from former averages of 150 market bunches yearly per acre to a new average of 300 and current highs of 400 more and better fruit from fewer acres.

Almost half of all market bananas are still grown by "independents," native farmers with limited acreage These have been particularly hard hit. To help these small farmers. United Fruit installs the new-type pipeline spray equipment upon the land and provides necessary services—without taking the property in hock The owner contracts to sell market-grade bananas to the company for a period of ten years at producer's prices common to the area The company agrees to pay

cash for all fruit purchased and assures the grower a market for his entire production the year around, regardless of market conditions Spray systems are being installed in units averaging about 880 acres, with spray lines crossing boundaries of private farms.

Science, too, has had its wits tested in this battle. At present the conquest of Sigatoka appears to be man's most spectacular victory over a crop-destroying fungus. To make the victory stick will require unceasing vigilance, but in that vigilance as well as in the conquest, science will learn new strategies. These strategies will stand us in good stead later, for fungi, not insects, may yet prove the chief enemy of man.

OUR POINT OF VIEW

Co-Operation

SO vast is the sea and so great are the numbers of food fish in it that any attempt to conserve the supply for the future may seem, at first glance, like carrying coals to Newcastle. But the facts point the other way One particular species of salt-water fish — the striped bass — is rapidly approaching extinction, and what can happen to one species can conceivably happen to another. And if the "striper" of our eastern coastal waters can be preserved by co-operative application of the science of conservation, the same can be done for other species when the need arises

The striper is a fish that is of tremendous interest to both commercial and sport fishermen Even when caught by the commercial fishermen in small quantities, the high price that the striper commands makes it rather worthwhile prey To the sport fisherman, whose numbers are increasing by leaps and bounds the striper is considered to be the king of surf and bay fish The commercial fisherman contends that he has an inalienable right to net and trap these fish wherever found. The sport fisherman claims an equal right to the fish and to the beach along which the fish travel

Here is where the need for more knowledge and co-operation comes into the picture Little is known of the life and habits of the striper, although several groups are now engaged in studying them and data are slowly piling up When more is known about these things, everyone concerned will be in a better position to determine future policy and procedure In the meantime sport fishermen of several eastern states are pressing legislation to protect the striper from the commercial fisherman, and the latter is just as active on the defense

To this writer, it seems that the greatest need at the moment is two-fold co-operation; co-operation between the legislative bodies of the various states in whose waters the striper is found, and between the sport and commercial fishermen Greed on the part of either or both of these groups should not be permitted to cause the striper to go the way of the buffalo, the heath hen, and the passenger pigeon The science of conservation has progressed sufficiently to enable us to show what steps should be taken. Protection of the species is a positive necessity if it is to be preserved. Let us hope that this prize fish, so eagerly sought after by those who go down to the sea for sport, will not become extinct while the battle rages. Rather put severe restrictions on *all* fishermen first and then iron out the difficulties later, making readjustments as found necessary. At least this would preserve one of our natural heritages from extinction until tempers cool and the way is opened for satisfactory co-operation —*A P. P*

Arms Against War

MANY attempts have been made to explain the present stalemate in the war between the Allies and Nazi Germany. No longer do people call it a phoney war; some, indeed, see in it a ray of hope for the future, a hope that the terrible bloodshed of 1914-1918 may never be repeated.

All wars are waged to wear down the enemy. To do this in the present war, each side thinks to starve the other out. Both know the futility of attacking along the French-German line, for both understand that the attacker would suffer enormously higher losses than the defender. There remain the sea and air. War on and under the sea has been put under control. The air, however, still has its menace. Aircraft are feared, not because they kill many civilians but for the deadly gas they can carry and because of their potentialities for the destruction of property. Small squadrons of planes have been active, but so far there have been no waves of hundreds of planes over enemy cities as was threatened. Why? Fear of reprisals? Britain evidently leans toward this theory if we can judge by an editorial in *The Engineer* (London).

In discussing safety measures taken in the British Isles to assure low casualty rates in case of air raids, *The Engineer* states "It is impossible to estimate how many millions of pounds have been spent in this country on these air-raid precautions, and up to the moment of writing, it can only be said of them that by their mere existence they may have averted attack Dread of reprisals is the most effective A. R. P. of all." We have confirmation of this dread of reprisals in Hitler's own words, the substance of which was that Germany had a weapon which could not be used against Germany In making such a statement, he knew what all belligerents know, that, despite a certain difference in quantity of arms, the theme of this war is *quid pro quo*.

One further thought from *The Engineer*: "It would seem that man finds himself in possession of a weapon so terrible that he dare not use it save against the defenseless." In speaking thus of the deadliness of aircraft, *The Engineer* approaches closely to a thought we have held for months. It has been our feeling that the very deadliness and enormity of modern armaments have done more than all the cries of horror by the pacifists during the past decades, if not to stop war, at least to limit rigidly the bloodshed of a modern war between powerful nations. While the burden of armaments is a heavy load for populations to bear in peace times, it seems to us that this war may yet prove that it is the armaments themselves which have more effect than common disarmament which renders a country defenseless It may follow from this that all peoples may see the utter futility of armed warfare, between equals, in the future and devote their energies solely toward the sort of economic warfare which is being waged today — *F D. M*

Printing's Semi-Millenium

FIVE hundred years ago, if we can agree on the date, 1440, that has long been accepted, Johannes Gutenberg invented movable type In the last five words of that sentence, there is basis for volumes of philosophizing

Prior to Gutenberg's achievement, some thousands (or tens of thousands) of scribes laboriously made copies of books by hand Consequently, books were costly and could be owned by few, the learning of the ages was passed on largely by lectures; and culture was a plant of extremely slow growth.

Following Gutenberg, civilization's processes were speeded up and the world passed through its most amazing 500 years of progress Today a book which only a king could buy before Gutenberg, can be bought by any child out of his pocket money, and millions of people, from writers to compositors and pressmen to lumberjacks and paper makers to news dealers and truck drivers, have employment because of movable type. (Somewhere, too, the over-worked, much maligned, necessary evil called "editor" fits into that list)

Technically Gutenberg's accomplishment was "re-invention," for the Chinese invented and used movable type many centuries earlier. Yet we have no desire to subtract one iota of the honor due this "scion of a patrician family of Mainz," as a recent bulletin from Germany proudly described him. His contribution to the broadening of culture, and therefore to the more rapid progress of civilization, is incalculable. It is unfortunate that war prevents the world from joining with Germany in her several celebrations this year to pay homage to this great and beneficent inventor. — *O. D M.*

More Miles Per Gallon

Fuel of the Future . . . Car of Future Designed For It . . . Both Will Come Through Co-Operative Research . . . Future Presaged by Past Progress

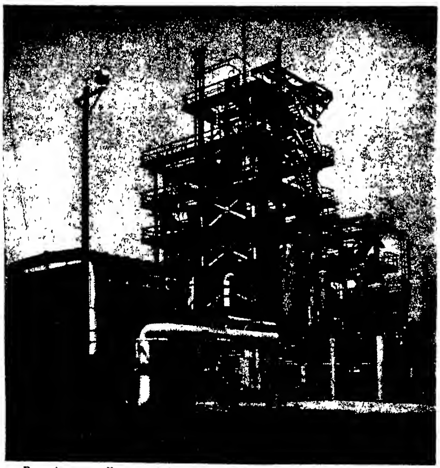
By Dr. GRAHAM EDGAR
Vice President and Director of Research, Ethyl Gasoline Corporation

IT is a virtual certainty that the automobile of the future will travel farther on a gallon of gasoline than the car of today In all likelihood this gain, possibly as much as 50 percent, will come, not through any sensational discovery, but by following a path already well beaten — the continued correlated development of fuels and engines

In the past, automotive engineers have taken advantage of constantly improving fuel quality by increasing the compression ratio with resultant increases in power per cubic inch of displacement and power per gallon of fuel The improvement of the anti-knock quality of gasoline is a necessary part of this correlated development because the tendency of fuel to knock limits the ability of the spark-ignition engine to convert the energy of fuel into power As this limiting factor has been removed permitting higher and higher compression ratios power and performance have improved The recent rise in the anti knock quality of gasolines available to motorists indicates that this trend is continuing

The possibilities of increased gasoline economy through developing this principle still further have been amply demonstrated by exhaustive experiments Research engineers using an automobile equipped with a valve-in-head engine as a test vehicle, conducted a series of tests in the laboratory and on the road at a number of compression ratios and gear ratios Fuels in each case were just capable of avoiding knock — approximately 69 octane for 5 25 compression ratio, 95 octane for 8 0 compression ratio, and something over 100 octane for 10 3 compression ratio At 40 miles per hour, the miles per gallon improved from 12 5 at 5 25 compression ratio to 18 at 8 0 and 21 at 10 3 The average increase in economy, between 10 and 60 miles per hour is about 45 percent, going from 5 25 to 8 0 compression ratio under conditions of constant performance

Distribution of leaded gasoline has expanded enormously since first sold here in 1923



Part—just a small part—of the vast chemical industry that has been built up since 1923 to make tetraethyl lead for gasoline. This unit produces ethylene

Super-charging, generally applied so far only to aircraft, opens another field of opportunity for improved gasoline economy Investigations in our own laboratories indicate that under certain conditions super-charging will result in substantial fuel savings, or in substantial increases in horsepower-hours from the same fuel consumption and, in some cases, both With 10- or 12 octane number-improvement in the fuel, it was possible almost to double the horsepower of an eight-cylinder engine by super-charging

Unquestionably one of the important industrial advances of this generation has been this correlated development of fuels and engines — a development that has changed our whole system of passenger and freight transportation Out of it has grown a system of motor transportation unrivaled anywhere in the world — bus and truck lines that stretch into every nook and corner of the nation, 25,000,000 private passenger cars, transcontinental, intercontinental, and trans-

Fairchild Aerial Surveys Inc

Bromine is extracted from the sea at this plant on Kure's Beach, North Carolina Water from the Atlantic Ocean, not shown, is pumped into the settling basin in the foreground, from which 200 million gallons a day flow into the processing plant

oceanic air lines on regular schedules

Behind this development lies the collective effort of dozens of research laboratories representing many industries All have made important contributions to the general program of improvement Not least among these contributions was that made by tetraethyl lead in breaking down the barrier of knock Tetraethyl lead was but one of the tributaries of the stream of progress, but, judged by any scale of values, it played an important role Many of the facts about it have become a matter of general knowledge, others are not so well known

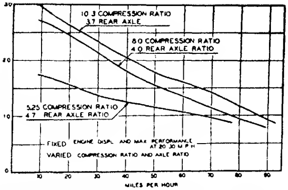
Almost every motorist is familiar with the small white sign on gasoline service station pumps which reads "Contains Lead" Some are familiar with the story of the recognition of the problem of knock by Charles F Kettering of General Motors, with the long search by Thomas Midgley, Jr., and T A Boyd for a satisfactory anti-knock compound and the eventual discovery of tetraethyl lead But few know of the obstacles that had to be overcome before this anti-knock agent could be made available commercially; of the problem of raw materials, of manufacture, or the years of continuous research that were necessary to the utilization of the product after it was developed

Gasoline containing tetraethyl lead was first put on public sale at a single service station in Dayton Ohio on February 1 1923, under the now familiar name of "Ethyl" gasoline Immediate acceptance of the new product indicated that the ordinary fuel of that day was not satisfactory for even the low-compression automotive engine of the time and the sale of Ethyl gasoline began to spread rapidly By 1931 12 percent of the entire gasoline consumption of the United States was Ethyl gasoline, sold at premium price. In April, 1933, oil companies began using tetraethyl lead in their regular-grade gasolines. Today, 75 percent of all gasoline sold in the United States and Canada contains tetraethyl lead. In the field of aviation, almost all gasoline of 80 octane number, or better, contains tetraethyl lead, in fact the performance of the modern military and transport plane is due, in large part, to the development of high-octane gasoline, a development in which this anti-knock compound played an important part.

Outside of the United States, tetraethyl lead is used in motor gasoline extensively in England, France, Australia, New Zealand, and Germany, and to a smaller extent in many other countries. In aircraft, for both military and transport purposes, it is used in nearly every country in the world.

But this success story could not be told had it not been for the years of study and research on problems concerning which the general public knows little or nothing Developing a product in the laboratory is one thing, manufacturing it in commercial quantities is quite another The manufacture of tetraethyl lead has represented serious problems from the start There was no "prior art" in the large scale production of any organo-metallic compound, and knowledge had to be accumulated by gradual and sometimes painful experience Three plants in succession were built, used for a time, and then abandoned before we learned to make tetraethyl lead in substantially the way it is manufactured today

It was necessary, first of all, to solve the serious problem of adequate supplies of basic raw materials Tetraethyl lead is manufactured by the reaction of ethyl chloride with an alloy of sodium and metallic lead, and the immediate raw materials are therefore ethyl chloride, sodium, and lead With the exception of metallic lead, none of these are available commercially in the quantities required, and for this reason, as well as in the interest of manufacturing economy, it was necessary to produce them at our own plants. An accompanying diagram gives a flow sheet of the manufacturing operations. Salt is electrolyzed to produce sodium and chlorine



Increase the compression ratio of the car engine and the result is more miles per gallon at a wide range of car speeds

The sodium is melted with lead to form the alloy which, after grinding, is ready for the final reaction. The chlorine formed in the electrolysis is burned with hydrogen to form gaseous hydrochloric acid.

Recently a plant has been completed for the manufacture of ethyl chloride, using the ethylene process — the first commercial development of its kind. The plant is a model of manufacturing efficiency and economy, but it took years of study and work to develop this particular art to its present state. In the ethylene process, refinery stabilizer gases, consisting largely of propane, are cracked, and the cracked gases are fractionated at low temperatures to separate the ethylene formed. This is allowed to react with hydrochloric acid gas at low temperature in presence of a catalyst to produce ethyl chloride.

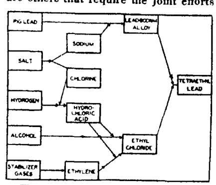
In addition to tetraethyl lead, the finished anti-knock fluid requires the addition of ethylene dibromide, ethylene dichloride, and dye. The latter two are purchased in the open market, but an adequate supply of ethylene dibromide at reasonable cost has represented a serious manufacturing problem for many years. In the early days of Ethyl, bromine was an expensive chemical and the supply limited. The young tetraethyl lead industry spent half a million dollars on a boat to "mine" that great reservoir of raw materials, the sea. The experiment itself was not an unqualified success, but it proved that bromine could be recovered in quantities with the proper kind of plant, equipment, and location. Subsequently, such a plant, the only one of its kind in the world, was built at Kure's Beach, near Wilmington, North Carolina, under the joint auspices of the Ethyl Gasoline Corporation and the Dow Chemical Company. Its present output exceeds three million pounds of bromine a month.

But the solution of these problems was only the beginning. Assured of an adequate supply of raw materials, the next step was exhaustive tests of engines on dynamometer blocks and millions of miles on the road to determine the exact proportions of certain constituents of Ethyl fluid for most satisfactory results. This is a study which must go on endlessly. Every new development in engines and fuels calls for renewed effort to determine whether or not changes in design or operating conditions may indicate the desirability of changes in the composition of anti-knock fluid.

These are problems specific to tetraethyl lead, but "lead" is also a part of the tremendous and intricate problem of the internal combustion engine and its fuel. When the full implications of the problem of knock were understood, the petroleum refiner set about to produce motor fuel of less and less tendency to detonate. The magic wrought by oil technologists in this connection is a matter of record. Cracking has been developed from what was originally merely a method of obtaining more gasoline from a barrel of crude oil to a method of changing the chemical structure of hydrocarbons. To the fundamental tools of temperature and pressure has been added the valuable instrument of catalysis.

The anti-knock quality of fuels is of vital importance to automotive and aircraft engineers. They must keep informed regarding the fuels that are available, and that soon may be available, and must design their engines to utilize these fuels as efficiently as may be practicable. They have other problems peculiar to their particular craft. With every increase in compression ratio, with every few pounds additional in brake-mean-effective-pressure, a host of problems present themselves. New materials and improved design may be needed. Difficult lubrication problems may arise.

In addition to the problems peculiar to each of these great industries, there are others that require the joint efforts

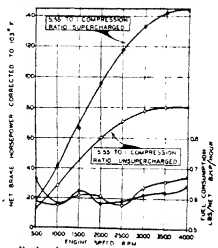


Flow chart of tetraethyl lead manufacture, showing chemicals needed

of both. Methods of measuring the knocking tendency of fuels, methods of expressing those measurements and the interpretation of the results, call for co-operative work by the technical staffs of the petroleum and automotive industries.

The Ethyl Gasoline Corporation is directly of neither the petroleum industry nor the automotive industry, but it is a child of both; and as such, it has been able to participate in many of the developments outlined above. Its research laboratories at Detroit and San Bernardino have not only studied problems specific to tetraethyl lead but have contributed substantially to the important progress which has led to the fuel and the engine of today.

It cannot be said that any of these developments have been due to a feeling of pure altruism on the part of any member of either industry. They are the natural result of the American competitive system, and their net result is that the public today has vastly better fuels



Brake horsepower and fuel consumption with and without supercharging in engines under tests

and vastly better automobiles, trucks, busses, tractors, and airplanes than it had ten years ago.

But what of the future? Will anti-knock compounds continue to play the same important role in the correlated development of engines and fuels in the future as they have *in the past*? No one would be rash enough to predict the exact trends which may develop in the future, but enough data exist to show that a number of ways exist in which fuel of very high anti-knock value may be efficiently utilized.

What that fuel will be, no one can say. Constant progress in the refining art is increasing both the yield and quality of gasoline. But wherever it is more economical to obtain any given octane level by the use of anti-knock compounds, they will continue to be used and they will be added to the best available refinery product to produce the "fuel of the future" for which the automobile of the future will be developed.

What Does The Soil Need?

Scientific Fertilizing Produces Remarkable Results . . . Possible When Soil Minerals, Soil Needs Are Known . . . Proper Tests Give Answer To Grower

By H. T. RUTLEDGE

FIVE-INCH rosebuds, daffodils the size of salad plates, snapdragons six feet tall — such remarkable products of flower gardens are being reported by amateur and professional gardeners who are experimenting with the latest scientific methods of fertilizing Similar results are being achieved by some vegetable and fruit growers

Often applications of commercial fertilizers bring spectacular results, while in other cases use of the same fertilizer may bring little or no benefit The reason for this anomaly is easy to find when fundamentals are considered. In the first case, improvement is visible and may be extraordinary if the material supplied by the fertilizer is lacking in the soil In the second case, results will be negligible, or even non-existent, if the soil already has the materials which the fertilizer supplies, yet needs still others. The obvious conclusion is that the grower must first know the requirements of his soil, otherwise the fertilizer may be completely wasted

WHEN the grower does know his soil, he may begin scientific fertilizing In theory, the problem of perfect fertilizing is complicated by the fact that plant requirements are many, varied, and still partially unknown. In practice, it is greatly simplified because all but three of the important plant food elements are ordinarily bestowed without the aid of man These three are easy to test for and easy to supply.

There remain some difficulties for the average gardener. Individual plants have different needs. The plant food content of the soil may vary widely within an area of a few square yards, and at different times of the growing season But a little study and systematic effort will show the way to a fertilizing program of maximum effectiveness.

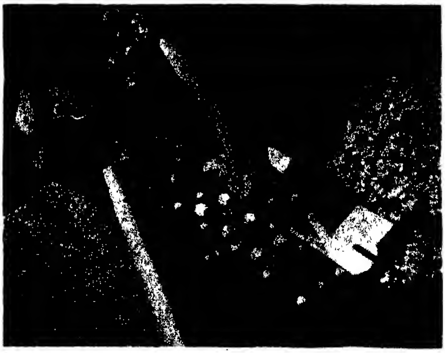
The three plant food elements which the gardener must usually add to his soil are nitrogen, phosphorus, and potash. Until recently, most people were content to use some general fertilizer which, it is true, did contain certain amounts of each of these essentials But it would be partly luck if the gardener supplied the right food elements in the right amounts He either wasted money by adding elements of which his plants already had enough, or he added too little of certain elements, and his garden suffered

Hit-or-miss fertilizing usually means failure because there are so many important factors which it does not take into account. Drought and rainfall, sun and shade, affect the amounts of plant foods available in the soil Plants themselves are continually depleting the soil of its nutrients, and their needs vary

The amount and kind of fertilizer required depend on the condition of the soil at a certain time, in a certain place, and in relation to the needs of the plants that are being grown By the use of simple but effective soil test kits, the gardener can determine for himself the degree to which his soil is deficient in nitrogen, phosphorus, and potash The kits are easy to use, demanding only the ability to follow simple instructions and to compare colors accurately With this information, the gardener can fertilize correctly — giving his plants the optimum quantities of foods which they would otherwise lack In view of the constant changes in soil conditions, best results are usually obtained by making periodic tests and feeding frequently in rather small quantities Larger applications at long intervals do not assure a regular diet of the foods that plants are using every day.

The fertilizing is comparatively simple once the soil has been tested If there are no unusual deficiencies, the gardener can often use a complete fertilizer, selecting a formula in accordance with his determined needs When certain elements are very low special concentrated fertilizers may be used — either directly on the soil, or mixed with a "complete" fertilizer material Nitrogen may be furnished by nitrate of soda, ammonium sulfate, or calcium nitrate, phosphorus by superphosphate, treble superphosphate, or steamed bonemeal, and potash by sulfate or muriate of potash.

The special needs of individual plants should also be considered in laying out a fertilizing program. It is important, in this connection, to remember that nitrogen contributes especially to the development of leaf and foliage; phosphorus to fruit and flowers; and potash to strong root growth. With identical soil conditions, a lawn requires more nitrogen in its fertilizer; the flower garden, more phosphorus; and beets, carrots, radishes, and other root vegetables, more potash.



With any soil testing kit, the tester uses but a spoonful of soil. Then, following simple instructions, he soon learns just what minerals his soil lacks—and needs

Stars That Have Chemistries

Certain Classes of Stars Have Atmospheres Like the Familiar Oxidizing and Reducing Atmospheres of the Chemical Laboratory . . . Low Temperatures

By HENRY NORRIS RUSSELL, Ph.D.
Chairman of the Department of Astronomy and Director of the Observatory at Princeton University Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington

THE stars as a whole are very varied Some of them are a million times as bright as others, a thousand times as big, a hundred times as massive, and ten times as hot on the surface Before we can study them satisfactorily, we must separate them into groups which are less excessively different from one another

The easiest way of doing this is to photograph their spectra With a prism in front of a wide-angle lens, we can get many hundreds of legible records on one plate Most of them, as everyone knows, show line patterns of a few standard intergrading types Once in a while one used to come upon a queer one, unlike the general run, but as observation advanced, it became clear that these, too, belonged to classes of stars, similar among themselves, but less numerous than the main types At the present time, when hundreds of thousands of spectra have been examined, it would be hard to pick out a single one which is not at least fairly similar to a few others Nature evidently has standard ways in which the stars may shine, very few in number compared with the multitude of the stars themselves

Among these less numerous groups are two closely related ones, denoted in catalogues by the letters N and R, and less technically, but more intelligibly referred to as the "carbon stars."

There is good reason for this name. Their spectra are cut to pieces by an enormous number of lines, grouped in many places into dense bands, which have long been known to be produced by carbon compounds These have now been identified not as the ordinary molecules familiar in our laboratories, but as molecules partly, but not completely, decomposed into their elements at the high stellar temperature So we have now *CH* — with but one hydrogen atom remaining attached to the carbon -- instead of the familiar CH_4 (methane), *CN* — not the cyanogen gas (C_2N_2) of the text-books, but a chemical "radical" so eager to combine with something that under ordinary conditions it combines with itself, and C_2 — carbon vapor ready to condense into a solid except at very high temperature or low pressure

In the red end of the spectrum, the lines are so crowded that they almost overlap. Here and there, a narrow clear space between them allows the normal "continuous" spectrum to show through With moderate or even fairly high, dispersive power these bright places look just like emission lines For years they were supposed to be due to some unidentified luminous gas, until at last the detailed comparison of spectrograms taken with high dispersion with laboratory spectra revealed the truth

The presence of compounds — molecules — in obvious abundance would be proof by itself that these stars are cooler, on the surface than most others. This was realized first, however, because they are very red The N stars, indeed, are much the reddest of all the important groups beginning about where the others leave off, with a color index of two magnitudes (that is, with about six times as much red light in comparison with violet as a star of standard color, like Vega) and running on to some which are 50 times as bright in the red as in the violet The R stars are in all respects less extreme They are not so red, the bands in their spectra are weaker, and those with the weakest bands grade naturally into familiar spectra of about Class K (Arcturus). They evidently represent cases in which all but a relatively small part of the compounds are dissociated by higher temperatures

THERE are other red stars in the heavens (called Class M) and a few of them are as red as even the N stars, and these too have compounds in their atmospheres But these compounds are *oxides* Titanium oxide gives the strongest bands — and, in a few stars, zirconium oxide — but oxides of vanadium, scandium and yttrium have recently been identified

It would be wrong to conclude that these unfamiliar metals are the most abundant in the stars Their oxides happen to have strong bands in the smallish part of the spectrum which we can observe Other metals, which do not, will be missed

But the fact that we find compounds of carbon in one sort of stars, and of oxygen in the other, is of great significance Here, indeed, we come to the point where we can speak of a real chemistry of the stars

The high-school laboratory student knows perfectly well the difference between an oxidizing and a reducing flame In the first, there are enough oxygen atoms to provide more oxygen than is necessary to combine with the hydrocarbons of the gas supply, and the excess oxygen, at the high temperature, will act on any oxidizable substance on which the flame plays In the second there is not enough oxygen to use up all the hydrocarbons, and the excess will take oxygen away from many metallic oxides, and leave the free metal

It was the late R H Curtiss, a dozen years or so ago, who first pointed out that in these two classes of stars, we have the familiar difference between an oxidizing and a reducing atmosphere With oxygen in excess, the carbon compounds are used up (being transformed into the more firmly bound carbon monoxide, which absorbs only in the far ultra violet) and the metallic oxides are left With excess of carbon, the opposite happens

The oxygen stars of Class M are something like 100 times more numerous than the carbon stars of Classes N and R That is, we find about this proportion in our lists of stars down to the 7th or 8th magnitude Among the 6000 or so stars visible to the naked eye the fraction is even smaller There are only about 20 of Class N, and but one of Class R – and most of these are variable stars which rise above the 6th magnitude only at intervals

But it would not be safe to conclude that oxygen stars were actually far more abundant than carbon stars, in space until we knew at least the average real brightness of stars of the different classes Those of great luminosity can be seen at greater distances, and will get into our lists in disproportionate number

It is therefore of special interest to determine, if we can, the average distance and real brightness of the carbon stars

These objects are much too remote for direct measures of parallax by the trig-

onometric method, and to get a good average we must depend upon the comparison of proper motions and radial velocities The principle is simple. By the spectroscope we can find the rate of approach or recession of any star, in kilometers per second By comparing observations of right-ascension and declination (if we have good enough ones covering a long enough time) we can find how fast, in seconds of arc per year, the star appears to move across the heavens This last amount — the proper motion — depends both on the real velocity of the star, at right angles to our line of sight, and its distance More precisely, it is proportional to the product of the cross velocity by the parallax

For an individual star, this leaves us none the wiser, for the ratio of the components of velocity along and across the line of sight depends on the angle between the direction of motion and the line of sight — which may be anything But when we can take the average for a considerable number of stars we can trust the laws of chance to give us pretty reliable values

AN apparent complication — but a real advantage — is introduced by the Sun's motion in space If the stars themselves were at rest, this would cause them to appear to drift in the heavens toward the point away from which we were moving, and, knowing the speed of the Sun's motion and the angle at which its effects were foreshortened for a given star, we could calculate good parallaxes for each one When the random motions of the stars are added to this, we must take, not the motion of an individual star in the drift-direction, but the average for a large number, and trust the individual motions (which are about as likely to be in one direction as opposite to it) to "average out" This will never happen exactly, but, for the average of 100 cases, it is an even chance that the outstanding effect will be not more than one tenth of the motion of an individual star.

We can get a quite independent determination of the mean parallax by taking the proper motions of the stars at right angles to the direction of the drift These depend on the motions of the stars themselves, in a specified direction at right angles to the line of sight Now we can find the "peculiar" velocities of the stars themselves, along the line of sight, by subtracting from the observed velocity the effect of the Sun's motion, which can be very easily calculated.

We now take averages for the available stars — simply of the numerical values, disregarding the positive and negative signs — and trust that the mean will "average up" in the same way in one case as in the other If there is no tendency for the real velocity of a star to be greater along the line of sight than across it (which should be substantially the case for stars scattered all over the sky) we should get good average values — indeed it is found that the average result for 100 stars should be right within 7 percent half the time

This method was first applied to the N stars by Kapteyn, in 1910 The material then available was sufficient only to show that they were very distant, and among the brightest of all classes of stars

Propped up diagonally in this little museum on a public square in Corning, New York, the first of the two 200-inch glass mirror disks (the slightly imperfect one) is now available at all times, without a particle of previous formality or even an entrance fee, for all who wish to come there to inspect it This is the mate to the largest piece of glass on earth, the one cast later and sent to California On a pinch it could even have been ground and polished and used in the telescope, and still could be so used in a tighter pinch However, because one of the 114 cores embodied in the mold for the purpose of leaving the disk ribbed or skeletonized at the back melted loose during the pouring of the molten glass and left solid glass in its place, it was decided to cast a new disk This was done in 1934 and that disk is now being prepared in Pasadena, California

Thirty years of observations now provide enough material for a much more accurate value. and a thorough discussion has recently been published by Dr R E. Wilson. There are now 106 stars of class N for which fairly good proper motions can be determined Combining these with the radial velocities (which have been observed for 145 stars) and using both the methods just discussed, he finds that an average N star of magnitude 7.3 has a parallax of 0″.00166, which corresponds to a distance of 2000 light-years The corresponding absolute magnitude is −1.6, which indicates a luminosity 300 times the Sun's Certain refinements of calculation raise this to nearly 400 times the Sun's light

These are therefore very luminous bodies If we could measure the total energy radiated, including the invisible infra red we would obtain much higher values — probably at least ten times as great The N stars are therefore giants of a pronounced type There does not appear to be much difference in the visual luminosity between those in which the carbon bands are strongest and least heavy, but, as the former are probably cooler, the total energy radiated is probably greatest for the "latest" types, as it appears to be among the M stars

They are much brighter, by any standard, than the average M star, so that our lists represent a hunt for them in a large volume of space, and they are still rarer than the first counts indicated

The R stars are fewer and fainter, and only 37 of them are available for discussion For these, by similar methods, Dr Wilson finds an absolute magnitude of −0.5, or about 120 times the Sun's visual luminosity

ONE third of the R stars, and four fifths of the N stars, are variable in brightness Most of them vary irregularly and over a moderate range (not exceeding two magnitudes), though some are periodic, and a few have the large ranges characteristic of variables of class M

The physical conditions in these remarkable stars are still imperfectly understood. Unfortunately we have no way of getting at their masses, and finding to what degree they obey the general rule that bright stars are massive Their surface temperatures must be among the lowest known, but are difficult to estimate, on account of the way in which the bands cut up the spectrum Their diameters must therefore be very large, and gravity at their surfaces low What keeps them shining is still a puzzle — as for all the other giant stars, and how they came to differ in composition from the oxygen stars is a question which physics — even nuclear physics — is not in a position to inquire

One curious fact should still be mentioned Not a single carbon star has been found among the hundred and more of red dwarfs which have so far been observed. Since there are probably at least 200 or 300 oxygen stars to one carbon star among the giants in a given region of space, it may well be that we have not yet a sample of dwarf stars big enough to include one and it is premature to theorize about it —*Mt. Wilson Observatory, January 29, 1940*

MAN'S EARTHLY FUTURE

How Long Will Our Earth Survive, and How Long Will the Species Called Man Endure on It? . . . Man's Fate: Either Oblivion or Improvement

By KIRTLEY F. MATHER
Professor of Geology at Harvard University

(In Two Parts — Part One)

DURING the first decade or two of the current century, geologists, astronomers, and physicists engaged in many discussions concerning the future of the Earth as an abode for life. Some believed that "the end of the world" was relatively close at hand; others that the prospect for the future was to be measured in terms of hundreds of thousands if not of millions of years As usual in scientific circles there has emerged from the conflict of ideas during the years of discussion a general unanimity of opinion, and today the geologic outlook for the future of the Earth is quite clear.

Since the turn of the century new methods of measuring the length of geologic time have been discovered and applied. New concepts of the nature and sources of energy have been proposed and tested New data concerning astronomic space and the distribution of the stars have been secured. Innumerable details of Earth history have been deciphered to give a trustworthy record of the changes which the Earth and its inhabitants have undergone in the past The key to unlock the secrets of the future is now available in this knowledge of the past, and with our present understanding of the processes of nature that key may be intelligently used. All the evidence combines to lead us unmistakably to the conclusion that for many scores if not for hundreds of millions of years to come the Earth will continue to be a comfortably habitable abode for creatures like ourselves

Surface temperatures of the Earth, the most important item in any consideration of its long-range habitability, are determined by the receipt of solar energy distributed through atmospheric agencies For any given area of land the annual contribution of heat from the Earth's interior, hot though it may be, is just about equal to the warmth received from the Sun in 20 minutes by an equal area in equatorial latitudes under a clear sky at mid-day The 19th Century picture of an Earth, initially fiery hot but progressively cooling so that yesterday it displayed a glacial climate and tomorrow it will be too frigid to support life, may now be thrown into the discard The Earth will "grow old and die" only as a result of failure to receive adequate supplies of radiant energy from the Sun The prospect that the Sun will "burn itself out" in a decrepit old age is so remote as to baffle all attempts to date that untoward event even by those who are expert in the juggling of astronomic figures Nor is there any likelihood that the space-relations between Earth and Sun will change appreciably within scores of millions of years to put the Earth either too close to the Sun or too distant from it for comfort.

The lurid pictures of a sudden catastrophic debacle resulting from collision with some other heavenly body — comet, planet, star, or what you will — are products of a vivid imagination wholly without foundation in astronomic fact or theory.

THE only plausible alternative to the conclusion that Earth and Sun will continue the even tenor of their ways for an inconceivably long period of time is that the Sun will some day imitate the super-novae occasionally detected among the stars and terminate the existence of the entire solar system by a gigantic explosion Precisely one such super-nova has been observed within the galaxy of the Milky Way and several such in all the other galaxies of stars during the last few decades The astronomers could therefore calculate for us the chances on a statistical basis that any individual star — the Sun, for example — would suffer such a fate within any given period of time. The result would be a figure so infinitesimal as to set at rest the mind of even the most jittery of questioners. Pending the discovery of the kind of premonitory symptoms displayed by stars about to blow themselves to atoms, the best that can be done is to rest content in history. Since the earliest records of living creatures were left as fossils, if not indeed since the earliest sedimentary rocks were formed, the Sun has faithfully maintained its energy output within a fairly narrow range and has given no evidence of any fluctuations that might suggest any significant change in its behavior.

The geologist may therefore turn with confidence from the long perspective of geologic past with its one-and-a-half to two billion years of recorded Earth history to a similarly long prospect for the future Time is one of the most overwhelming resources of our universe.

It should not be inferred, however, that the Earth will continue in the future to display the same environmental conditions as those which we enjoy today The history of mankind thus far has been enacted against a background that in the full perspective of Earth history is truly extraordinary The geologic period in which we live is a time of unusually rugged and extensive lands with notably varied climate ranging from the glacial cold of Greenland and Antarctica to the oppressive warmth and humidity of certain equatorial regions. Such conditions have apparently recurred many times at long-spaced intervals since the oldest known rocks were formed, but added together the time thus represented cannot be as much as a fourth of geologic time. Much more characteristic of Earth history as a whole have been the conditions illustrated by those periods when corals thrived in shallow seas occupying the site of Baffin Land and North Greenland, and coal-forming plants flourished on Antarctica The probability is strong that eventually, say in five or ten million years, the Earth will display again the physical conditions of many past geologic periods that were characterized by broad low lands, wide shallow seas, and uniform genial climate

But most of us have a greater interest in the next few centuries than in the subsequent millions of years Minor changes in climate will doubtless occur just as they have in the last few thousand years Unfortunately, or perhaps fortunately, there is no basis for prediction concerning their nature, whether for better or for worse There is really no good reason for referring to the present as "a post-glacial epoch"; it may prove to be an interglacial epoch. But our ancestors weathered ice ages in the past and presumably we are better equipped for such contingencies than they were. Should the average annual temperature of the Earth as a whole be reduced something like 10 degrees, Fahrenheit, and

From the Eighteenth Sigma Xi Lecture, delivered at the recent Columbus, Ohio convention of the American Association for the Advancement of Science

remain at that lower level for a few millenia, it is likely that once more the greater part of Canada, the northern United States, and the Scandinavian countries would be buried beneath great ice sheets. But in consequence of the removal of water from the sea as vapor to form the snow to produce the glacial ice, considerable areas now shallowly submerged along the coastlines in middle and equatorial latitudes would emerge as dry land. Indeed, it is likely that the area of land suitable for human abode would be nearly or quite as great at the climax of a glacial period as it is today.

By the same token, the disappearance of existing bodies of glacial ice as a result of rapid amelioration of climate in the not-distant future would, if it occurred, be a decidedly mixed blessing. Return to the sea the water now imprisoned in the ice on the Arctic islands, Greenland and Antarctica, without any compensating changes in crustal elevation, and sea level would be raised 50 or 60 feet the world around. Considering the number of people who now work or sleep in buildings in metropolitan communities not over 50 feet above sea level, the importance of such a change is readily apparent.

But from the geologist's point of view these are relatively trivial matters. With due deference to the nature of the climatic variations and geologic changes which are certain to occur in the next few thousand years, there is nothing to be expected from such sources that would seriously deter the human species from maintaining a comfortable existence on the surface of the Earth for an indefinitely long period of time — a period to be measured in millions rather than in mere thousands of years.

AT last, it is generally understood that man is a part of nature. He may be something more than an animal (that depends largely upon definition), but he is none the less truly a part of the animal world. Like the other inhabitants of the Earth, man is a product of evolutionary processes operating on this particular planet.

We may be the last products of the creative forces displaying themselves in the organic development taking place in this particular portion of the cosmos, but we have no reason to assume that we are the last achievement of those forces. Nor does the fact that man has arisen from a lowly origin through processes of evolution validate the optimistic inference that he will necessarily continue his progress to ever higher levels of activity. Evolution does not guarantee progress, it merely guarantees change. The change may be for the better or the worse, depending upon the conditions of time and place and the vitality of the individuals concerned.

The pages of Mother Earth's diary reveal an amazing and thought-provoking record of the progress of living creatures throughout the long eras of Earth history. Again and again, in the procession of the living, dynasties of animals or plants have arisen from a humble origin to a position of world supremacy, maintained for a comparatively brief period and then lost forever.

Drawing the teeth of environment. In modern structures such as this (Fifth Avenue, New York, building of the Corning Glass Works), man, more now than ever before, is in near control of his environment. Here little pieces of an always comfortable world that does not often exist outside are created artificially. Man is the only animal which has been able to do this

Some have disappeared entirely as their paths have led them off into blind alleys. Others have sunk to a low level and have continued a degenerate existence to the present day. A few have given rise to other and more efficient forms of life which superseded their predecessors as leaders in the procession. Gradually we are discovering some of the reasons for success and failure along the path of life. Beyond question, man may profit from these experiences of the past, if he uses the intellectual and moral resources which are available for him.

From the point of view attained through knowledge of geologic life development, man has today a unique opportunity to gain continuing security for himself and his progeny on the face of the Earth, but whether or not he takes advantage of that opportunity is to be determined largely by himself. So far as we can tell, man is the first animal possessing the power to determine his own evolutionary destiny, but there is nothing in the record which guarantees that he will use that power wisely.

The animal species that in the past have been able to maintain their existence for more than two or three million years are relatively few in number. Most of them were comparatively simple types belonging to the less highly organized branches or phyla of the animal kingdom. Many were inhabitants of the sea where environmental conditions were remarkably stable throughout long periods of time. Among placental mammals, the major subdivision of the vertebrates to which man belongs, there is no similar record of longevity. Except under extraordinary conditions of geographic isolation, no species of placental mammal has persisted more than two or three million years. No matter how successful it may have been temporarily in multiplying and spreading over the face of the Earth, each has become extinct in a geologically brief span of time. Perhaps a half million years might appropriately be taken as the average "life" of a species in this group of highly organized and notably complex creatures.

BUT extinction does not necessarily mean failure, it has frequently indicated the acme of achievement. For example, some of the now extinct three-toed horses and four toed camels passed on "the torch of progress" to their descendants the one toed horses and two-toed camels and thus gained long-continuing security for their kind.

What then does the future hold for mankind? *Genus Homo* has already existed for three or four hundred thousand years, the species *Homo sapiens* has about 50 000 years to its credit. If the average applies, we may expect nearly or quite a half million years more of existence for our kind and then either oblivion as we reach the end of a blind alley or progressive development into some type of descendant better adjusted than we to the total environmental factors of the time.

But does the average apply? Must man exit from the scene through either of the doors, that which closed behind the dinosaurs and titanotheres or that which opened before the three-toed horses and notharctines?

Most creatures have gained security by specializing in adjustment of structure and habit to particular environmental conditions, whereas man is a specialist in adjustability of structures and habits to a variety of environments. No other vertebrate can live as can he on Antarctic ice cap, in Amazonian jungle, beneath the surface of the sea or high in the air.

Furthermore, man is the world's foremost specialist in transforming environments to bring them within the range of his powers. Far more efficient than the beaver or the mound-building ant, he drains the swamp, irrigates the desert, tunnels the mountain, bridges the river, digs the canal, conditions the air in home, factory and office.

As a matter of fact, adjustability to environment is accomplished more by

controlling surroundings than by modifying internal organs or essential functions of the body. When we ascend with Major Stevens into the stratosphere, or dive with Doctor Beebe 500 fathoms deep off Bermuda, or live with Admiral Byrd through the long night of Little America, we take along with us a sample of sea-level atmosphere and temperate climate which is our real environment in a situation otherwise unbearable. Fur lined parkas and tropical linen suits are but a medium for ensuring an immediate environment as nearly as possible like that of middle latitudes when living in polar or equatorial surroundings.

But, regardless of interpretation of procedure, the result is clear. Man has placed himself in control of external conditions to an extent immeasurably greater than has any other creature. He has practically "drawn the teeth" of environment.

ALTHOUGH we know little of the details, it is certain that most of the creatures of the past who "have had their day and ceased to be" were forced into extinction by changes of one sort or another in their environment, changes which came with such relative speed that they were unable to make adjustment to them in time. Man need have no fear on that score.

It is, however immediately apparent that man's conquest of his surroundings has resulted from his clever use of things. Unless there is a ceaseless flow of cotton, flax and wool, of coal, iron and petroleum, of copper, lead and tin, from ground to processing plant to consumer, he becomes a puny weakling. It is because he uses certain resources provided by his environment that he is freed from slavery to his environment. Are these resources adequate to keep him supplied with what he needs to maintain indefinitely the sort of existence to which he has accustomed himself?

There are two fundamental sources of the goods and the energy which man uses in the grim business of securing the sort of living which he apparently desires. On the one hand there is the farm and the waterfall; on the other there is the mine and the quarry. Things which grow in the field or forest, and power produced by falling water are in the category of annual income. Now that scientific research has made available the limitless quantity of nitrogen in the air for use as fertilizer the resources of the plant and animal kingdoms are renewable, we use them, but we need never use them up. In startling contrast the resources of the mineral kingdom are non-renewable, they are in the category of accumulated capital. Petroleum and coal, copper and iron, lead and vanadium, these and many other prerequisites of modern civilization have been accumulated by nature through hundreds of millions of years of geologic activity. Thanks to scientific research, man is exhausting that store of mineral wealth in a few hundred, or at most a few thousand years. That inescapable fact is at rock bottom one of the most fundamental causes of economic distress, of war between nations, and of strife between classes.

Fairly accurate estimates of the world

Courtesy *National Petroleum News*

Photographs like this, showing oil wells afire and wasting thousands of barrels of oil, will be dug out three generations hence, from the musty files of the magazines of 1940 and reproduced again, so that posterity, to whom we shall transmit but a meager supply of petroleum, may curse our prodigality in recklessly wasting a resource which we know to be non-renewable. Opinions differ widely. Some simply remark, "Why worry?" and quote that shopworn wisecrack. "What did posterity ever do for us?" True we may learn to get heat direct from the Sun, lubricants from other sources than petroleum, energy from the atom, but are we sure?

stores of many non renewable resources are now available. Take petroleum as an illustration. The known available reserves of petroleum beneath the surface of the United States total at present approximately 17 billion barrels.[1] Experts differ in their guesses as to the quantity of petroleum that may be discovered in the future in areas that have not yet been adequately explored with the drill or in known fields by discovery of deeper reservoirs not yet reached by the deepest wells in those fields. There are also many varying shades of optimism and pessimism concerning the possibility of increasing materially the percentage of recovery of the oil present in a reservoir rock when penetrated by drilling operations. Estimates of the quantity to be added to our petroleum reserves from these two sources range from seven or eight billion barrels to 15 or 20 billion. I would incline toward the larger figures considering them as maxima which are extremely unlikely to be exceeded. On that basis, the present store of available petroleum beneath the surface of the United States is 25 to 35 billion barrels. That is only about 30 times the annual domestic consumption of petroleum in recent years. The average annual production of petroleum in the United States during the five years from 1934 through 1938 was almost 1,100,000,000 barrels,[2] and the 1939 production exceeds 1,250,000,000 barrels. At the present rate of withdrawal, the domestic stores of this essential raw material would, therefore be exhausted in less than a third of a century.

DATA are not nearly so precise for the majority of foreign countries as for the United States. It is, however, fairly safe to conclude that the world stores of petroleum will last only some thing like 75 years at the present rate of withdrawal. With the possible exception of Mexico, no other country has been as successful as the United States in the attempt to exhaust its petroleum resources in the shortest possible period of time, but rapid progress toward that result is now being made in many regions.

Lest we become too pessimistic in response to such unwelcome figures, we should promptly note that substitutes for petroleum are already known. Gasoline, fuel oil and lubricating oil can now be manufactured from coal and other rocks rich in carbon, by processes of hydrogenation and polymerization. These are expensive processes and their products cannot now compete with the products from petroleum even in countries far removed, both geographically and psychologically, from the more productive oil fields.[3] They will, however, come into use more and more in the next few decades.

Enough bituminous and sub-bituminous coal is known to be available within the United States to meet the present annual demand for coal, plus enough to manufacture gasoline and fuel oil in sufficient quantity to meet current demands for at least 2000 years. In addition there is enough oil shale — a rock rich in carbon but containing little or no oil — to meet present needs for petroleum products for at least three or four thousand years.

(*To be Concluded*)

[1] "Petroleum Reserves Are Estimated by Institute Committee at New Record Total," *American Petroleum Institute Quarterly* Vol 9 No 2 p 7 1939

[2] Statistics from "Minerals Yearbook," published annually by the United States Bureau of Mines

[3] K O Heald, "Technology and the Mineral Industries, WPA National Research Project, Report E-1, pp 27-31 1937

Half-empty condition of one of the Croton reservoirs during the 1939-40 water shortage

When Water Shortage Threatens

Lessons Learned by New York City . . . Prolonged Wet Spells Give False Sense of Security . . . How Wastage May be Decreased to Conserve Supply

By EDWARD NUEBLING
Division Engineer Department of Water Supply Gas and Electricity City of New York

NEW YORKERS have been so accustomed to obtaining, at a mere twist of the wrist, an unfailing supply of clear, wholesome water that the probability of a water famine seems well nigh incomprehensible However the shortage of the winter of 1939-40 intensified by a dry spell that began May 1939, is not the first of its kind, the city's history is punctuated with water crises of varying degrees, with even the early settlers of Manhattan having their troubles In fact, the story of New York's water system is a chronicle of the city's constant growth and the efforts of the system to keep pace

The Dutch inhabitants in the 17th Century were the first to encounter difficulty The increasing density of the growing population was making private wells unfeasible, as well as insanitary, and the year 1658 marked the construction of the first public well and the decline of the individual type

By 1832, the population had grown to nearly 200,000. Water conditions were intolerable An epidemic of cholera was the impetus that led to the development of the Croton Watershed, 35 miles north of the city A small dam was built across the Croton River at a point where it drained an area of 352 square miles By the summer of 1842, work on the aqueduct had progressed sufficiently to permit water to flow from the Croton River to a distributing reservoir in the city The aqueduct had a capacity of 90 million gallons a day, and some engineers confidentially predicted that the water supply problem had been solved for all time But the city continued to grow and it became apparent that the yield of the watershed had been overestimated

At least the impounding reservoirs were too small to maintain the required supply through the long dry spell that started in 1880 and caused the city to experience its most harrowing water crisis the following year In September 1881, rigid emergency measures had to be taken to reduce the consumption outlet gates of the reservoir in the city were partially closed, public fountains were shut off, street sprinkling was stopped, appeals were made to the public to economize on water consumption The heavens finally relented and a long rain saved the situation It is a matter of record that another ten days of dry weather would have left the reservoirs as dry as the Sahara and the city's 1,200 000 inhabitants would have been without water

By 1885, the Croton Aqueduct had become inadequate to furnish the supply of water needed in the city, thus creating a shortage that was not due to weather conditions Work was begun on a new aqueduct having a capacity of 285 million gallons a day Water was delivered through it to the city, for the first time in 1890. This was none too soon for the Old Croton Aqueduct was being forced to deliver water beyond its safe carrying capacity and was being subjected to pressures for which it was not designed

In 1895, a new supply of 20 million gallons a day from the Bronx and Byram Rivers, near the city, was made available Three years later, Greater New York came into being through the absorption of the various communities lying in and about New York Harbor, the consolidated city includes the boroughs of Manhattan and the Bronx (the former city of New York), Brooklyn, Queens and Richmond The population of the Greater City in 1898 was 3,272,420 of which 1,976,570 resided in Manhattan and the Bronx

Upon consolidation, all of the publicly owned plants within the greater city were placed by statute under the jurisdiction of the Department of Water Supply Some 16 privately owned plants continued to be operated by the owners Three large plants, one in Brooklyn and two in Queens, are still in operation

Shortly after consolidation, the necessity was foreseen of providing a large additional supply of water for the greater city as a whole So in 1907, construction

Courtesy of *Water Works Engineering*

was started on the development of the Esopus and Schoharie Watersheds in the Catskill Mountains, 100 miles north of the city However, construction work was started too late to avert another shortage of supply in 1911 The Croton Reservoirs were far below normal, and the supplies available to the other boroughs, which were obtained mostly from underground sources, were inadequate to meet the demand

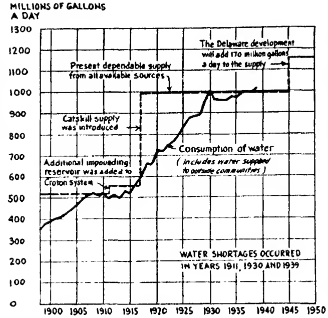
The emergency measures of 1881, as well as new ones, were taken to relieve the condition For the first time, systematic underground waste work and house-to-house inspection for the detection and suppression of leaks was tried This waste work was instrumental in holding down consumption until the present Catskill source was added to the system in 1917

The last water shortage incident occurred a decade ago It was the peak of the boom period In a city of New York's size, there is a definite correlation between business conditions and water consumption, good business means increased production, and many industries use large quantities of water A prolonged dry spell at this time (1930-1931) found the reservoirs emptying at an alarming rate The Department of Water Supply's first action was to employ emergency measures similar to those used so successfully in 1911 But it was not long before the repercussions of the stock market debacle began to be felt in industry At this juncture, and with a more immediate salutary effect on the water supply, capricious Nature dipped into one of those unpredictable wet cycles which was destined to last nearly a decade In the frenetic period of unemployment and national upheaval that prevailed, people soon forgot that there had been a threatened water famine

BUT the engineers and experts of the Department of Water Supply and the Board of Water Supply, a separate organization empowered to develop large additional sources of supply, did not forget In fact, they had anticipated the shortage, had been seeking an additional water source for a number of years The upper Delaware Watershed, adjacent to the Esopus and Schoharie Watersheds, was finally decided upon as the best new source of supply

The concomitant wet cycle tended to imbue many people with a false sense of security Among these people was a group of citizens who minimized the necessity of the costly Delaware project. They admitted the need for a new water supply in the near future, but believed that universal metering was the logical solution

Water was then, and is now, sold to domestic consumers in New York on a flat, yearly basis Under universal metering, each consumer would pay for the exact amount of water used This system, it was contended, would eliminate waste and extravagant use and would result in an estimated saving of 200 million gallons a day It was further pointed out that the cost of metering would be one tenth the cost of the Delaware development and would take one fifth the time In other words, it was held that the Delaware development would add another heavy burden upon the taxpayers, whereas metering would not



New York City water consumption and supply

The proponents of the Delaware project counter-argued that when completed it would bring 540 million gallons a day to the city The constantly increasing population and the inevitable necessity of the project was emphasized

It was finally decided to proceed with the $273,000,000 Delaware project Looking back now, it is agreed that both projects should have been started simultaneously But then, there was the question of money, which was, as usual, the main bone of contention

The Delaware project is to be built in two stages Actual construction on the first stage was begun in 1936 and will be completed about 1945. It will bring 170 million gallons a day to the city The commencement of the second stage, which will bring an additional 370 million gallons a day, will be held in abeyance until the necessity for a larger supply becomes apparent.

Normally, 90 percent of the city's supply of water comes from impounding reservoirs in the Catskill and Croton Watersheds. The last reservoir added to the system was the 20,000 million gallon Schoharie Reservoir, which was placed in service in 1926 This brought the total available storage capacity of the Catskill and Croton systems up to 285,000 million gallons. While this enormous quantity of stored water would at the present time be used up in less than a year, it would have sufficed liberally for all of the wants of the old city from the time of settlement up to 1842 when Croton water was first supplied, a period of 230 years. The slow growth of the city in its early period lends truth to the saying that "water supply establishes a dead-line beyond which no city can grow with safety and health." Shortly after Croton water was introduced, the per capita consumption increased from 35 gallons a day to 80 gallons, and, in the following 15 years, the population was doubled

IN April, 1939, all of the reservoirs were full nearly to overflowing At the close of the year owing to low rainfall and run-off in the watersheds, there remained in storage only 129,000 million gallons During the nine months from May through December, the reservoirs were depleted at the rate of 620 million gallons a day This rate of depletion, if continued, would leave the reservoirs empty by the summer of 1940.

In 1939, the consumption of water from municipal sources of supply averaged 963 million gallons a day. Of this amount, 22 million gallons a day were supplied to communities outside the city Private water companies operating within the city furnished 60 million gallons a day, bringing the total city's supply up to 1023 million gallons a day. The population served, including outside communities, is estimated at 8,000,000 In addition, some 500,000 commuters enter and leave the city daily.

The dependable source of supply—that is to say, the supply of water that can be made continuously available through prolonged drought periods such as the city might now be passing through—amounts to only 990 million gallons a day. The demand for water last year exceeded the dependable supply. The only reason that the city is not now confronted with empty reservoirs and a water famine is that drought conditions did not prevail throughout the year and that private water companies are still pumping from ground water beds that are nearing exhaustion.

To remedy conditions, the Commissioner of the Department of Water Supply, Gas and Electricity, Joseph Goodman, outlined the following courses·

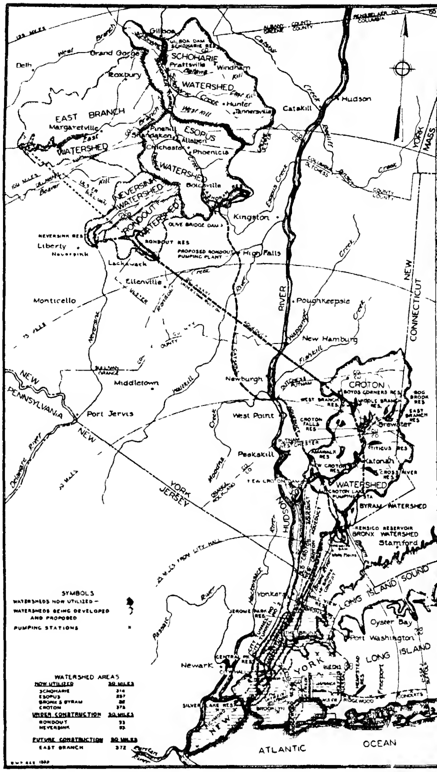
1. Appeals to the Public to Stop Waste· The low stage of the impounding reservoirs was first called to the at-

tention of the public through the press last October. Heads of city departments have since been requested to repair all defective water fixtures in buildings under their jurisdiction The use of water for street cleaning has been reduced to a minimum Posters were displayed in all cars of the subway lines giving notice of the low stage of the reservoirs to the several million passengers who travel on the lines daily. One and a half million folders, calling attention to the water shortage and the necessity for stopping waste from leaking faucets and toilets, were printed for distribution in schools and through other public and private agencies. In addition, the municipal and other radio stations helped with spot announcements, reminding the citizens of the water shortage and requesting co-operation in reducing waste

2 Development of Additional Wells In Long Island When the Catskill supply was introduced in 1917, Long Island well sources were for a brief period discontinued However, as the city grew, the well supply was again drawn upon to supplement other sources Measures will now be taken to rehabilitate old wells so that the entire available supply may be utilized, and also to provide additional wells The additional wells will add 50 million gallons a day to the system However, the approval of the State Water Power and Control Commission must be obtained before this development can be undertaken

3 Detection and Suppression of Leaky Fixtures In Buildings The last house-to-house inspection was made with WPA labor from 1934 to 1937 The survey took in 473,000 buildings, revealing 400,000 leaks In one section of the city, one toilet out of every five examined was found leaking Over 50 million gallons a day were being saved at the time of the project's discontinuance Since new leaks are continuously developing, house-to-house inspection must be repeated periodically to be of lasting benefit. At the present time, it is estimated that virtually all of the saving made on the last survey has disappeared and that by instituting another campaign, the consumption can again be reduced some 50 million gallons a day

4 Detection and Suppression of Underground Leakage· Water is conveyed from source to consumer through a vast and intricate underground network of 5000 miles of water mains and 640,000 service pipes. Leaks in this subterranean system develop at the rate of 20,000 a year. Most leaks appear at the surface and are promptly repaired. However, an appreciable number flow through underground channels During the past ten years, a special force of men has been ferreting out these leaks in Manhattan and the Bronx, covering the two boroughs about once in three years It has maintained a saving of about 30



Present and future water-supply areas for New York City

million gallons a day that otherwise would have seeped irretrievably into the soil Underground waste work is also being done by a WPA force in Brooklyn and Queens. Enlargement of the present force and extension of this work to all five boroughs should raise the savings to a total of 50 million gallons a day.

5 Reduction of Pressures: It is estimated that well over 200 million gallons a day is now being lost from leaks in water fixtures and underground pipes. Obviously, by reducing the pressure in the pipes, the amount of leakage will be decreased. This method of reducing consumption, however, will be employed on a large scale only if it should become necessary to avoid emptying the reservoirs completely

It is estimated that the conservation measures outlined above, when in full swing, will reduce the demand for water in the city by 80 million gallons a day This saving, plus the additional well supply, may suffice for the needs of the city up to 1945

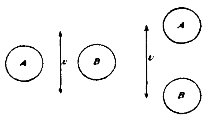
SOUNDLESS SOUND WAVES

Supersonic Waves in Science and Industry . . . For Smoke Precipitation, Emulsification of Liquids, in Fishing and in War . . . Sounds that Burn

By WALTER L. FINLAY, Ch.E.
Research Chemical Engineer Remington Arms Company

(In Two Parts—Part Two)

EGOCENTRIC Man, unless he favors the Boston State House, usually considers himself the hub of the universe From his point of view, a sound wave is that which he hears, from the universe's viewpoint, however, it is a longitudinal vibrational disturbance, usually of the air Thus is resolved the apparent contradiction in the title of this article If the disturbance vibrates faster than about 20,000 cycles per second it is inaudible to human ears



From Gottschalk and St Clair in *Mining and Metallurgy*

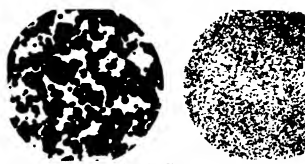
Figure 1 An illustration of the "principle of Bernoulli," which is used in precipitating fumes

and these soundless sound waves are called ultrasonics

Apparent contradiction is not confined simply to the title but extends as well to the behavior of ultrasonics For example, by dipping the bulb of a glass thermometer into an ultrasonically-vibrated oil bath one can enjoy the unique experience of having one's fingers burned despite the fact that the object held is, as evidenced by the thermometer reading, at all times at room temperature Or, if ultrasonic vibrations are applied to an arm or a leg, the bone remains at the normal body temperature but the marrow is heated The explanation lies in the fact that glass and bone conduct ultrasonic vibrations much more efficiently than do flesh or marrow The latter absorb the vibrations and, as a consequence, become heated.

An interesting illustration of this heating effect is given by a simple experiment A mixture of water and ice will maintain a constant temperature of 32 degrees, Fahrenheit, regardless of whether it is heated or cooled, until either all the ice has melted or all the water has frozen Hence, if a newly formed block of ice made from distilled water is immersed in a bath of cracked ice and water and ultrasonics are applied, both the bath and the block will remain at 32 degrees, Fahrenheit But if after some exposure to the waves, the block is then squeezed, it will shatter like "rotten" ice, indicating that the vibrations had caused liquefaction at the grain boundaries Natural ice—that is, pond ice—does not exhibit this effect presumably because it is a single crystal

The vibrational energy which burns the fingers holding the thermometer previously mentioned can be concentrated in a point with rather curious results If the neck of a glass flask is heated and drawn out into a point, and the body of the flask is immersed in an ultrasonically-vibrated bath, the vibrational energy will be concentrated at the point A pine chip held on the point will be penetrated in short order by a combination of drilling and burning Even a plate of glass will have a hole drilled through it and during the process, tiny globules of molten glass will be flung off in a miniature shower



From Dr B Claus in *Zeit techn Physik*

Figure 2 **Showing how ultrasonic vibrations facilitate the emulsification of some highly immiscible liquids** ***Left*** **Result without vibration** ***Right*** **With vibration**

But ultrasonic vibrations provide more than just the mainspring of a magician's hat, for they have several rather important industrial applications Ultrasonics of suitable intensity, for example, can precipitate tobacco smoke or the fumes of NH_4Cl, P_2O_5, SO_3 or HCl in one second This precipitation effect has been explained by Gottschalk and St Clair as an illustration of Bernoulli's principle In effect, this principle states that the pressure in a fluid is least where the velocity is greatest Thus, in Figure 1, at the left, the direction of vibration, that is, of motion of the air molecules, is perpendicular to the line of centers Hence the pressure between the particles is lessened and the particles coalesce In the same figure, at the right, the particles, oriented in a different direction, are urged apart but it is simply a matter of time until they are properly oriented to other particles for coalescence Settling therefore is rapidly effected

PRECIPITATION of smoke and fumes is an illustration of the ability of ultrasonics to destroy dispersions of solids or liquids in gases But these paradoxical vibrations are also able to produce dispersions of solids or liquids in liquids Such highly immiscible liquids as mercury and water can be transformed into rather stable emulsions by ultrasonic radiation alone And if mercury is electro-deposited from an aqueous solution of one of its salts and is simultaneously subjected to ultrasonic vibrations, a much finer dispersion is obtained This can be observed by comparing the two halves of Figure 2, which were photographed at 2000 magnification

Just how this emulsification by ultrasonics is effected is not clear but a large number of solids and liquids can be dispersed by this method If an already existing dispersion of colloidal—that is, ultramicroscopically sized—particles is subjected to these vibrations the colloidal particles become still further divided Milk, for example, is an emulsion of fat, casein, and so on, in water The January, 1939, Scientific American (page 39) discussed how milk is now being commercially given a finer degree of emulsification by sonic radiation than Mother Nature was ever able to bring about, and Figure 3 shows the apparatus used. The advantage of this finer emulsification seems to be that smaller and

more easily digested curds are formed in the stomach. If the particles are already of molecular size, very slow further subdivision may still occur. For example, starch may be converted into dextrine, and cane sugar may be split into monosaccharides Of more practical importance is the fact that the homogeneity of photographic emulsions is improved by ultrasonic radiation As a result, it is possible to increase the silver halide concentration with a consequent increase in resolving power

IT has persuasively been suggested that the phenomenon of cavitation is the basis of ultrasonic emulsification but the exact mechanism of just how it brings about this effect is not yet clear Cavitation causes a tea kettle to "sing" just before boiling The harmony comes from a ballet of bubble dancers but, in this case, there is nothing behind the bubbles The singing arises from the condensation and collapse of steam globules as they rise into the colder water near the surface When this colder region becomes sufficiently heated the bubbles cease their Swan Song and start to boil The late Lord Rayleigh calculated that pressures of thousands of atmospheres might be developed at the moment of collapse and, of course, at highly localized spots That such pressures are no mere mathematical abstraction is indicated by the cited fact that, during maneuvers, after a destroyer had rushed for several hours at maximum speed, the armor plates above the propeller were completely eroded through over an area of almost one square foot Turbine and propeller design must, of necessity, take into account these cavitation effects in order to mitigate them Figure 4 illustrates the destructive pitting action of cavitation on the cast steel blade of a hydraulic turbine after 18 months' service

Courtesy Submarine Signal Company

Figure 3. **A two-foot, stainless steel diaphragm with hinged cover, as used for sonic treatment of milk**

In the ultrasonic radiation of a liquid, cavitation is brought about by the actual tearing apart of the liquid A sound wave is propagated in the form of periodic compressions and rarefactions of the propagating medium During the constantly recurring rarefaction phases of the vibration the liquid is literally stretched, and the resultant reduced

Courtesy *Metal Progress*

Figure 4 **What the phenomenon of cavitation in water did to the solid steel blade of a hydraulic turbine Pitted deeply, the surface is no longer smooth and as efficient as before Propellers similarly are pitted as a result of this odd phenomenon**

hydrostatic pressure permits either dissolved gases or vapor of the liquid itself to form bubbles Those bubbles which do not collapse are evolved from the liquid Application of this principle to the industrially important problem of removing dissolved gases from molten metals has formed the subject matter of several patents A corollary effect is the lowering by as much as two degrees of the boiling points of many liquids

Ultrasonics are conducted much more efficiently in water than in air In fact, communication and depth sounding are commercially carried out by its means In the "echo" system of depth sounding a burst of ultrasonics is sent out from a piezo crystal vibrated diaphragm on the ship's bottom After reflection from the floor of the sea these vibrations are picked up by another similar diaphragm The piezo crystal of the latter converts the vibratory changes in pressure to easily recorded electrical impulses and the depth is automatically calculated from the elapsed time between transmission and reception As many as 15 soundings per second can be made in this manner and an experienced observer can even distinguish between a mud rock, clay, or sand bottom The information obtained is of considerable value to commercial fishing trawlers To polish off this facet of the many-sided ultrasonics as a real fish story one need only relate that the exact location of close-swimming shoals of fish can be readily determined by the echo method The fanciful might thus suppose that Mary Mackerel and Cathleen Cod can sense a premonitory chill as the searching beam of ultrasonics puts the finger on their svelte sides

Much smaller organisms than mackerel or cod experience more than a merely premonitory chill To very small fish and vegetable growths like protozoa the initial chill is also the final one of death This lethal effect is probably due to the destructive action of the phenomena -- cavitation, degassing, and dispersion -- which accompany ultrasonics

Submerged submarines, by making use of the echo principle, can determine their position by determining the contour of the ocean floor and also while submerged, can locate, and fire topedoes at, an enemy ship Submarines can also communicate over distances as great as 10 to 15 miles and can concentrate the ultrasonic beam within one degree of the direction desired Tapping such a private "wire" presents something of a problem to an eavesdropping enemy

EFFICIENT as water is as a conductor of ultrasonics, metals are even more so However, inclusions, cracks, blow-holes in fact any discontinuities in the metal are potent sources of reflection or absorption of the ultrasonic vibrations Means for the non-destructive testing of metals is therefore provided by this phenomenon and a patent has been granted for this application

It has also been claimed that ultrasonics accelerate the nitriding and carburizing of steel both of which important processes impart a hard skin or case to steel, the former by compounding with nitrogen and the latter by compounding with carbon Later investigations, however did not substantiate these contentions Nevertheless, other processes in solid metals may possibly be expedited by these vibrations A super-heated liquid flashes into vapor and a supersaturated liquid immediately precipitates upon ultrasonic radiation By analogy one might expect that such extremely important metallurgical processes in the solid state as the precipitation-hardening of age-hardening alloys such as duralumin and beryllium bronze and the austempering transformation in steel could be similarly accelerated

These versatile vibrations are thus seen to be of interest to the scientist, to the industrialist and to the simply curious It is a relatively new field for most of the pioneering work in it has been done within the last 15 years And, although soundless, it seems quite probable that ultrasonic vibrations will be increasingly heard from in both industrial and scientific circles.

Railroads In The Cellar

Capitalization of Model Railroads Now Runs Into Many Millions . . . Serious Avocation . . . Men Form Exclusive Clubs . . . Run Trains Like Railroaders

By R. T. GRIEBLING

WHEN a boy buys his father a toy train for Christmas, when a western Pennsylvania wife obtains a divorce because her husband spends too much time in the cellar "building rail roads—little railroads," and when the president of a large eastern transportation system considers it perfectly proper to officiate at the opening of a model railroad, then it is high time to investigate a hobby that is breaking all records for sustained interest, and one which, because of its very nature, is going to stay with us for a long time

Building and operating model railroads is not child's play, as one would ordinarily surmise, although it may have had its start from an urge to provide the youngster with more realistic equipment But Junior isn't skilful enough to do the building himself Dad has to help, and before you know it, Dad is over his ears in a new hobby.

Immediately, the boy can forget about his train entirely It's Dad's now! And, incidentally, Junior isn't any too welcome when the trains are running. Model railroaders may love children, but they don't want them around expensive equipment, for children have an uncontrollable desire to handle the various pieces, and these must not be touched except with reverence

Time made the mistake of talking flippantly about model railroading not so long ago, and almost immediately received the following rebuke from J. H Bramble, of Farrell, Pennsylvania

"Your phrase 'plays with toy trains' is a red flag to all serious followers of the hobby Would you refer to a philatelist as one who plays with bits of colored paper, to an antiquarian as a collector of junk, to a fisherman as one who floats bugs on a string, or to a hunter as one who goes into the woods to kill things?"

They're touchy, these model railroaders, even worse than ping-pong players; and there are, according to best estimates, nearly 100,000 of them in the country But model railroading is not confined to the United States alone One manufacturer of model-railroad equipment is proud of the fact that he has customers in Canada, Mexico, Central America, Panama, Cuba, Puerto Rico, the Argentine, Hawaii, New Zealand, the Philippines, England, Belgium, Italy, Sweden, and France

It takes blue chips to play the game right, too, depending, of course, on the scale used There are cheap model railroad sets on the market — the hobby has already reached that stage — but the difference between one of these and a good set is as great as between a dollar watch and a fine Swiss movement Both tell the time, but the latter does it just a little bit better all the way 'round

Those of us who thought it was plumb crazy to pay up to $100 for a mah jong set, can get ready to be shocked all over again Thirty-five dollar locomotive assembly kits are as common as flies, and if you want a truly super-de-luxe engine, you'll pay as high as $295 for it And don't forget that this sum pays for only one power unit and a tender, a good model railroader, proud of his set, has several of them Cars, unassembled, will run from $3 50 to $10 Rail for tracks costs about 5 to 10 cents a foot (completely assembled track costs $1 a foot), and we haven't even begun to figure on ties, roadbed gravel, spikes, third-rail connections when necessary, frogs, switches, cross-overs, signal towers, waiting stations and other buildings, scenery, mannikins, transformers, and wiring

WIRING is not always a costly item, but in some cases it might well be. Consider, for example, the largest and most complete model railroad ever built — exhibited at the New York World's Fair The signalling system used 3,000,000 feet of wire. Other figures to make the eyes pop include 70,000 wood ties on 3500 feet of track, 125 switches, 10 double slips, 30 locomotives, and 400 pieces of rolling stock Six thousand miniature trees make up the forests, and 7000 gallons of water were needed for the waterways

If this model railroad is the ultimate dream of the enthusiasts, then it explains the entire hobby The attention given to detail is nothing short of remarkable, and therein lies the fascination that is exercised over both builder and spectator

The reason for model railroading's popularity is to be found in the ability to reproduce in miniature, with uncanny accuracy, the various pieces of equipment that go to make up a railroad. To build a coach with six-wheel trucks, when only four wheel trucks are used on the prototype, is rank heresy, and model railroaders would be booed by their brethren for such inaccuracy

Models built entirely by hand are museum pieces and take many months to execute. These are eminently not the ones that are found in model railroads. The tiny locomotives and cars that serve model railroads come either assembled or in kits unassembled. If they are of the latter variety, they can be put together in a reasonably short time It takes much longer, however, to lay the track and install the wiring system But anyone who has a knack for tools can join in the fun

Fastidiousness is the principal joy of the model railroader Everything must be "just like on the big trains," or else it has no real hobby value. All parts are built to scale, so that the complete outfit is actually a vest-pocket edition of the real thing

And that brings to mind another interesting fact about model railroading Ever since the Union Pacific streamliners made their appearance in 1934, the amount of aluminum used in model railroad construction has increased, principally because the Union Pacific's new trains employ so much of this metal. And the sales arguments used by the manufacturers are quite similar to those used by aluminum salesmen in real life

"Light weight and strength," says one maker, "are of vital importance in the manufacture of operating models, and this naturally brings us to the use of numerous aluminum castings."

"Duralumin rail," says another, "has everything in its favor Color similar to steel, will not rust, gives good bite to drivers, is hard but cuts and bends easily, no excessive slipping, good conductor of electricity, produces good sound effects as wheels roll over it, and is inexpensive"

Fully assembled units may be purchased at higher cost than kits, but most model railroaders have sufficient skill to put the unassembled cars together. They also have enough skill to build the platform on which the model system runs.

What a model railroader's cellar looks like. *Right*. The owner, S. T. Gustina, is shown in the foreground lowering a lift bridge. When the road is not in use, the bridge is lifted out of the way by counterweights. *Below* Classification yards with three locomotives and several kinds of passenger and freight cars A continuous landscape is painted all around the wall

***Below* On the main line! An aluminum truss bridge carries the track over the space before the vegetable cellar door Again, note background mountain scenery**

Another view of the lift bridge which carries the track across the room, showing cross-over switches, signal tower, and semaphore. A turntable, operated by a crank, is in the rear near where the track turns under the cellar step

This requires some knowledge of carpentering, but is not difficult

In model railroading there is even a place for the man who has no skill whatever but would like to indulge in the sport. Since elaborate systems are quite costly (even a real hobbyist can seldom afford them!), groups of enthusiasts band themselves together into clubs, collect monthly dues, hire some space, buy whatever equipment they need, add to this from month to month, and build the road in their spare time The skilled members lay the tracks and assemble the signal system; the unskilled members keep the books, figure out operating schedules, and do the other chores that are commonly done in real-life railroads. "Club night" to these enthusiasts means a night in the selected space or in the cellar of one or another member, "working on the railroad" And once they are at it, no interference is tolerated They are indeed serious, these model railroad men!

The model railroad has arrived. If each of the estimated 100,000 enthusiasts own 100 feet of track — and there are many who own more — then, by laying all sets together, it would be possible to run a single track line from New York to San Antonio, Texas, or double track from New York to Milwaukee

And if there are 50,000 model trains in use (the figure, to the best of our knowledge, is conservative), then on the run from New York to San Antonio you would meet a train every 200 feet. If you figure that there is $200 invested for every 200 feet of track ($75 for the carefully detailed locomotive, $10 each for six cars, $20 to $40 for 200 feet of track, depending upon the type of construction, and $25 for transformers, wiring, and control systems), then more than $10,000,000 has already been spent on this hobby

Some friend of yours may say to you, one of these days "I sure beat 'er on the back on the high iron last night!" If he does, please don't stare at him Remember, you have always thought of him as a respected, conservative citizen with a good job, a nice home, and all the other accessories of the more abundant life He's just talking railroad lingo, referring to the fast time his train made on the main line of his model railroad Bear with him. You might be the next one to get the bug.

Food By Vein

Hospitals are Beginning to Use the New Method of Supplying Food to Those Who Cannot Eat . . . The Expectations are Auspicious

By BARCLAY MOON NEWMAN

AN important new way to prolong life has just been discovered Food is now being given by vein to patients who cannot eat - because of excessive weakness at the time of operation or because the surgeon must cut some portion of the alimentary tract, as in removing a tumor The new method is already being used in hospitals and enables patients to survive digestive crises hitherto often fatal

Of course calories for heat energy have long been given by vein in the form of a solution of the simple sugar dextrose, and the body is thus supplied with a priceless source of immediate energy with which to run the human mechanism The indispensable carbohydrate component of the diet is taken care of in this way

Salt solutions also have long been provided by vein, and the mineral component of the diet is accounted for Existence for weeks is possible without vitamins, although they have in many cases been found to mean the difference between death and continued life Now a number of pure vitamins — including vitamin A, thiamin, ascorbic acid, riboflavin, nicotinic acid, B_6, D, E, and K — are commercially available and are injected as a common practice Some are safely given by vein, others by administration under the skin so that they are only very slowly absorbed into the blood Ultra-violet rays synthesize small quantities of vitamin D in the skin upon which such light is made to fall So the vitamin problem has not been a major obstacle to successful surgery and convalescence

The fat component of the diet can be dispensed with, for many days at least, if not weeks But even fat has been provided by injection In 1935, Dr Emmett Holt Jr, and his associates at Johns Hopkins Hospital made exceedingly fine emulsions of fat — olive oil — and injected the preparation into dying patients Improvement followed Inasmuch as fat is not only an essential nutrient and must eventually be taken if the patient is to remain alive but also a more efficient source of energy, weight for weight than carbohydrate, future developments in fat administration will be important and should bring new successes that will permit the patient to recover more rapidly

Water, sugar, mineral salt vitamin, and fat are five of the six nutrients known to be indispensable in human nutrition The sixth is protein, until recently the main obstacle in the way of perfecting the administration of food by vein, through an extended period

Now for the first time in medical history, there is a satisfactory substitute for protein-by-mouth Bases for the complete solution of the problem of intravenous feeding—of food by vein have been established The digestive tract can be completely dispensed with for weeks Meanwhile, it can in many cases be restored to approximately normal activity Thus the patient balks death

Illustrations from "Dextrose Therapy," monograph by E Martin, Sc D

One of the methods of injecting food by vein is by the syringe

Credit goes to Doctors Robert Elman and D O Weiner, of the Department of Surgery, Washington University School of Medicine, and of the St Louis City, the St Louis Children's, and the Barnes hospitals, St Louis

These doctors knew that it would be dangerous to try to inject into the veins even the most carefully purified protein such as casein from milk The blood and tissues of the body cannot cope with foods so intricate for protein is the most complex chemical structure in the world A first injection of casein would sensitize the body so that a second injection would result in a terrific shock, very likely to be fatal. This sensitization to protein is an unavoidable, normal body reaction, a condition like that of allergy is set up. It is the work, instead, of the digestive tract to break down proteins so that only fragments of the former huge molecules are made available for absorption

The ferments of the digestive juices are the catalysts that bring about this cracking of the protein molecule into its main constituents or component units, known as amino acids. Following such decomposition absorption of these simple chemical structures, the amino acids, occurs These building blocks of the proteins thus arrive in the blood stream, which transports them to tissues that in turn absorb them Once in the tissues throughout the body, the amino acids are, in utterly unknown chemical reactions put together so that new protein, the chief basis of living tissue, is synthesized Without a steady supply of amino acids tissues degenerate and die and the body dies With a steady supply of amino acids, usually derived from food protein, tissue is constantly regenerated to replace that which is lost in those activities which we call life.

TISSUES starving for protein become pathologically swollen with excess water, but when protein-building units are supplied, the swelling subsides Other less obvious changes take place and the patient grows stronger with the trend back to normal

To a limited extent, serum from a blood donor may be used to supply amino acids But even a quart of serum a day will not yield enough building blocks to construct the large numbers of protein molecules required throughout the tissues

Doctors Elman and Weiner had learned that in 1913, two other scientists, Henrique and Andersen, had kept a goat alive and gaining weight by food via vein. The source of protein building blocks, the amino acids, was meat whose protein had been digested in the test tube Also, Van Slyke and Myer had sent *digested* protein coursing through the blood vessels of dogs, and no harm had been done

With these favorable discoveries in mind, Doctors Elman and Weiner di-

gested casein with acid, and so prepared a mixture of most of the indispensable building blocks of protein. The acid, however, decomposed one of the amino acid units known as tryptophane, and casein, to begin with, is low in another, called cystine, an invaluable source of sulfur for protein, therefore the mixture was fortified with a small percentage of tryptophane and a little cystine—amino acids which can be bought on the market

The preparation was tried first on rats. They grew and thrived Further experimenting showed that the preparation was free from dangerous, undigested protein In this test, guinea pigs were used Repeated injection did not bring about a sensitized condition, and no shock resulted.

Next came the dog into which the amber solution of amino acids plus some sugar was injected Careful measurements of the level of amino acids in the dog's blood were then made, and it was found that the injected nutrients rapidly and safely disappeared from the blood, certainly to go into the tissues, there to be caught up in the swirl of life's chemical laboratories and made into canine protein. Little of it seemed to be wasted by way of the kidneys The method appeared to be efficient

In one set of experiments, the dogs were allowed to fast, and a certain quantity of blood was drawn, to reduce the quantity of protein in the blood serum Then amino acids were given by vein Re-synthesis of lost protein occurred within six hours after the injection of these protein-building blocks

IN another series of experiments, dogs were fed a diet free of protein, for several weeks Serum protein was observed to sink to lower and lower levels, and characteristic accumulation of water due to protein deficiency began to swell the tissues But when amber-colored amino acid-dextrose solution was administered by vein, the amount of protein in the dogs' blood serum rose toward the normal level The most careful examination, moreover, showed no damage to liver or kidney or other organ. Now for human beings

"Our first concern," the two pioneers report, "in giving digested casein to patients was, of course, the possibility of untoward reactions, even though none had occurred in dogs At first, small doses were injected, they produced no demonstrable effect, so that eventually we administered what was thought to be a full daily quota of amino acids, that is, from one half to two grams per kilogram of body weight "

A sense of warmth was noticed by one patient; a slight chill was felt by another, but the temperature remained normal. A child had a slight, transient rash after one of the injections.

In practically every instance, benefit came from amino acids by vein, and water-logging of tissues was diminished No injurious after-effect whatsoever could be seen All the tests gave proof of the body's use of amino acids to build up new molecules in tissues that had been starving for protein

Still, the substitute for food by mouth is only a temporary measure The present limit of food by vein is a few weeks at most One vein cannot be used con-

Food is also given by vein by a continuous method ("venoclysis")

tinuously, so vein after vein must be subjected to the inflow of fluid, and generally the first vein has not recovered sufficiently by the time all the veins have been used

We do, however, have a great beginning Deeper blood vessels may turn out to be available for use, when better techniques have been devised. When more is learned about protein-building amino acids probably some of the less important ones can be temporarily dispensed with, and the injected quantity kept at a minimum

Practical possibilities are increasing as amino acids become cheaper through improved commercial syntheses Drug manufacturers already have placed predigested casein preparations on the market, and with such solutions universally available for research, we can expect further notable developments

Perhaps we can look forward to a considerable extension of the periods during which patients can be kept alive though their digestive tracts are not working Approximately seven percent of all deaths after the age of 45 is caused by disease of the digestive system. This mortality should be reduced as the use of food by vein is increased through the development of refinements both from the nutritional side and from the mechanical side, where better methods of forcing fluids into veins are concerned The fluid undoubtedly will be made nutritionally more valuable The vein through which the fluid is forced will surely be more satisfactorily guarded against possible injury The stomach, the intestines, the liver and the pancreas will be given longer periods of rest and a greater opportunity to return to health

Fifty percent of cancer deaths is traceable to cancer originating in the digestive system Already, through the contributions of Doctors Elman and Weiner, a practical step has been taken toward helping the cancer specialist in his vast labors, operation is safer, because there is less danger of starvation following surgery of the digestive tract

UNDOUBTEDLY, the main dietary components are known to nutritionists and, by one method or another, injection has been made practical, at least to a degree But none would assert that the optimum proportions of the various food factors have been determined for one thing, age will have to be considered more carefully What percentages of what amino acids are best for the year old, the decade-old, the semi-centenarian, or the aged? Here a vast research for the future looms And, even if we now know enough about the main essential items of diet to keep a person alive with food by vein over a period of weeks, no scientist would state that other factors yet undiscovered, do not after a while become indispensable for longer life

Most experts believe that several additional vitamins are to be turned up, perhaps including vitamins M, P, and factors U and W, the evidence at present pointing to the existence of these and others

Not long ago, copper was added to the list of indispensable metallic elements included in the group termed "mineral salts" Some think that cobalt and zinc, perhaps other metals, in ultravisible quantities will turn out to be necessary

There are excellent indications also that dextrose does not altogether satisfy the body's demand for sugar There are other sugars, including the most remarkable of all galactose which is one half of the molecule of milk sugar, dextrose being the other half Galactose is abundant in brain and nerve tissue and present in considerable quantities in every tissue of the body No tissue (except that of the lactating mammary gland) is known to be able to synthesize galactose

None can ever say how far medical science will go Research brings astonishing powers to delay death Food by vein is a major advance in the science of prolonging life. The future of this system can certainly be awaited with high hopes

SCIENCE AND INDUSTRY

A MONTHLY DIGEST

Conducted by F. D. McHUGH

Contributing Editor
ALEXANDER KLEMIN
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"DAMP COLD" BETTER THAN DRY COLD

MODERN home air conditioning is gradually teaching us that one of our most widely cherished beliefs is a complete fallacy —the one that says "you feel 'damp cold' so much more than you do 'dry cold'." Actually, the National Warm Air Heating and Air Conditioning Association points out, the reverse is true Relatively high humidity causes low temperature to be less uncomfortable, and when people have learned this, they can begin really to enjoy the increased comfort, and even more the improved health, which can be provided by the simple type of air conditioning which is becoming the rule in modern American homes

It isn't the temperature that the thermometer shows that tells the whole story as to whether you feel comfortable, or cold, but the rate at which your body is losing its own heat The colder the air around you, the faster you lose heat, other things being equal, but other things never are quite equal Under most conditions you lose heat faster to dry air than to relatively moist air, faster to dense air than to thin air, and faster to air in motion than to still air And if you are in bright sunlight, even on a cold day, you receive enough radiant heat to make up for a lot of your loss, and so don't feel the cold so much The kind of cold people think of as "dry cold" is actually found in the thin air of high altitudes, on still days of bright sunlight, and what they call "damp cold" is that of a cloudy day with a raw wind, on which you lose heat faster, and there is less radiant heat from sunlight to make up for it

NEW KIND OF BLOOD BANK

MOTHERS, as they bring new life into the world, are also contributing blood that has life-saving properties in Massachusetts Memorial Hospitals, Boston This novel sort of blood bank is stocked with blood from the placenta, secured during normal, healthy childbirths through the cord through which the baby got its nourishment before birth After typing, to tell whether the blood will mix safely with the blood of a prospective patient, other tests and the addition of a special preservative, the mother's blood is stored for use, and remains good for three weeks and even longer This special sort of blood has a stimulating effect and is successfully used on desperately ill patients suffering from malnutrition, secondary anemia, hemorrhage after childbirth, and from certain types of cancer, ulcers, and gall bladder, stomach and bladder disorders —*Science Service*

MENDING PASTE PLASTIC

NEWLY arrived on the market is a multi-use paste plastic in colors, which should be welcomed by the home handy-man and hobby-crafter Packaged in small tubes and in cans under the name of Plastico Rok, this material is adaptable for use on those varied mending jobs that are always springing up in the home.

It is simple to use, clean, comes in ten beautiful colors and is an ideal mending material for cracks, dents, or holes, in wood, stucco, linoleum, and like materials. It acts as a powerful cement, besides the added advantage of allowing use of a binding material of the same color as the material or object being mended

Advantages of Plastico Rok are that no special thinner is needed and excess may be wiped off with a wet finger or a damp cloth Thus, it may be used on the finest furniture without fear of marring the finish After application, Plastico Rok quickly dries literally "as hard as rock"

"BICARB" FROM CLEANEST CHEMICAL PLANT

THE manufacturers of Cow Brand and Arm & Hammer Brand baking soda will probably say that their product is not now any purer, that it was always as pure as it was humanly possible to make it, but these two brands are now being made in what is said to be the world's cleanest chemical works

The modern plant of Church & Dwight Company, Inc, shown in our illustration,

Photograph courtesy The Austin Company

Functional design characterizes this modern chemical plant

is not only striking in appearance but is actually simply an air conditioned "package" to support and enclose conveyors, carbonating towers, and eight-story tanks lined with stainless steel. The plant has interior walls of glazed tile and functional panels of glass block instead of windows. Its entire framework was electrically welded, as was most of the equipment required for the new continuous process. Produced from start to finish in an enclosed maze of equipment, the bicarbonate of soda will not even come in contact with air inside the plant until it is ready for packaging.

Two things—motor trucks and the relatively new process of adhering rubber to metal—provide the modern means of transporting large quantities of chemicals shown here. This special trailer tank of 2500 gallon capacity is lined with rubber so that it will carry corrosive solutions. It is one of two such trucks put in service by the American Cyanamid and Chemical Corporation; the tanks were lined by the Goodyear Vulcalock process

Engineer Discovers "Lightning" Radiation

Discovery that lightning generates an ultra short wave radiation which it uses to open a path to ground through a lightning arrester after striking an electric power system, was reported recently by W. E. Berkey, research engineer of the Westinghouse Electric & Manufacturing Company. He made the discovery while experimenting with lightning arresters. He said the newly tagged radiation is emitted from the regions of an arrester's electrode-insulator contacts which are stressed by a lightning surge.

High-frequency radiation in the gap between the spheres makes the gap "fast"

By generating ions, or charged particles, in the air space separating the electrodes of a spark gap inside a lightning arrester, the radiation lowers the gap's resistance to the flow of electricity. It acts as a trigger to start the lightning surge jumping across the gap toward the ground. In engineering slang, it makes the gap "fast," when speed is dealt with in terms of fractions of a millionth of a second.

"As a result of our discoveries," Mr. Berkey said, "we can control and increase the intensity of this radiation and can improve the spark gaps of our lightning arresters."

The investigator described the radiation as being near the soft X-ray region of the spectrum, with a wavelength of approximately only 1000 Angstroms as compared with 5000 Angstroms for visible light. (An Angstrom is a unit of measurement so small that there are some 254,000,000 of them to an inch.)

Short-wave radio power which travels through the air at several million cycles a second appears to be loafing when compared with the frequency of the new radiation, which oscillates one quadrillion times a second. Because this radiation is absorbed in a few centimeters of air, it has escaped earlier discovery.

Glycerine Saves Plant Roots

Glycerine is hygroscopic. That is, it attracts and holds moisture. Therefore, when Dr. R. N. Du Puis, of Chicago, studied the problem of preserving the roots of young tomato and cabbage plants during shipment, he turned to this sweetish liquid.

Every year, millions of young tomato and cabbage plants are shipped long distances. Ordinarily their roots are packed in moist sphagnum moss. Too often the moisture dried out and the plants were damaged, so Dr. Du Puis thought of using a solution of glycerine instead of plain water to moisten the moss. As a result, more than 75 million plants were shipped satisfactorily during the last season with this glycerine-solution protection. It was found, incidentally, that the treatment also discourages the fungus that causes stem canker.

Encouraging results have also been obtained in the use of this solution with other plants such as narcissus, onion, potato, asparagus, and horseradish.

On the Hoof

Approximately seven million tons of live stock—enough to keep New York City supplied with meat for seven years—were transported by American railroads in a single year.

Display Signs Save Light Bulbs

The high light transmission and edge-lighting qualities of Lucite, methyl methacrylate, a du Pont plastic, have been utilized by the Lauv-Lite Corporation to make a new type of display sign, claimed to have several times as great visibility at less power consumption, and to operate at lower maintenance cost than other types. Limitless color effects are possible in these signs which, furthermore, are said to have no glare or dead spots.

The signs are made by outlining the desired letters, figures, or other patterns with small button-lenses of the plastic. These lenses, ground from small diameter rods, are fitted into holes punched through the face of the signs. The back of the lenses pick up light from a concealed source and carry it to the head of the lens, giving a sharp, bright glow. One lamp provides illumination for several lenses, and in the event that a lamp fails, enough light is picked up from other lamps to maintain visibility.

On-and-off and moving effects can be obtained in any color by using various color combinations of lenses and blinking bulbs.

The signs vary from small indoor counter displays to large and spectacular types for

outdoors. For the latter, Lucite's resistance to extremes of atmospheric conditions without discoloration or warpage, and its high tensile strength, are especially advantageous

Tractors by Air

ONE of our photographs shows a Bellanca Aircruiser specially modified for use in gold mining in the Philippines. The

Cargo hatch in miner's airplane

Davao Gold Mine is productive of untold wealth, as a gold mine should be, but is inaccessible and located in very rough country The Aircruiser brings to the mine such articles as a Diesel electric power unit, electric hoists, a Diesel engine weighing 4095 pounds It is apparently impossible to build a real road into this difficult country, but the airplane has not failed to meet all requirements Owing to the peculiar formation of the surrounding ridges at the mine, all landings are made towards the east, along the single prevailing direction of the wind —*A K*

PILOTS

IN mid-January, more than 35,000 hours had already been flown by the 9130 students in the Civilian Pilot Training Program, without serious accident of any kind Furthermore, a total of more than 1200 of these students had already reached the solo stage of instruction

Modern Training Planes

IN the World War I, the training planes were Curtiss Jennies and Standards with a top speed of 75 miles per hour, with all sorts of projecting struts and wires, logy and slow to respond to the controls

Even today, we are apt to think of a training plane as something like an Aeronca or a Cub – small, slow, and safe, but a military pilot who is to maneuver a 400-mile-an-hour single-seater, cannot possibly pass from a Cub class directly to the fighting class Our photograph shows the Curtiss Falcon 22 — a combat trainer which is the first of a large number just completed for a foreign government by the Curtiss-Wright Corporation

While designed for less spectacular service than the Curtiss Hawk Pursuit ships doing such remarkable things on the Western Front, the Falcon is a splendid example of modern military design Although it is a trainer, it incorporates every aerodynamic structural device of the day with perfect streamlining, retractable landing gear, all-metal construction The front cockpit is equipped for the pilot, while the rear cockpit is prepared for a gunner or observer or instructor or bomber

Performance figures give a maximum speed of 215 miles per hour at critical altitude, climb of nearly 5000 feet in three minutes, service ceiling of 25,900 feet, cruising range of 515 miles —*A K*

Pneumatic Seaplane Floats

AN interesting development is now reaching successful completion in the McKinley pneumatic floats for seaplanes The first application of the float is to small airplanes One of our photographs shows the pneumatic floats mounted on a Cub plane, a ship of no greater weight than 1000 pounds The PF 2 model float is 12 feet 9 inches in length and 22⅝ inches in diameter at the point of maximum girth The weight of each float is only 42½ pounds. The material used is of standard airship fabric type — long-fiber cotton treated with layers of rubber Special cement is used at the joints

The step, which is of importance in seaplane take-off, is tailored into the fabric.

Air-inflated pontoons

Spray tubes extend from the nose to the step These tubes, held in place by cement, divert the water in taxiing to a take-off, diminish spray, and also conduct a stream of air on the under side of the float, which aids in breaking the water seal

Each float is divided into five compartments, but in place of a rigid bulk-head separating the compartments, a fabric diaphragm is utilized. The fifth compartment in the nose also serves as a pneumatic bumper. The only rigid member in the float is a V-beam for attachment of the struts and to provide a walk This beam is of duralumin suitably protected against corrosion

Advantages claimed for the float are its shock-absorption qualities, its lightness, and economy in maintenance

In experiments extending over 300 hours of service, deliberate collisions have been made with driftwood, buoys and other objects at high taxiing and take-off speeds Resiliency was proved in every instance and no damage was incurred Drop tests have proved equally satisfactory —*A K*

Annual Report

THE Annual Report of the Bureau of Aeronautics, submitted by Rear Admiral J H Towers, gives a splendid picture of the energetic efforts of the Bureau of Aeronautics in advancing naval aviation Naturally, of course, it does not disclose the details of all that is being done

Glancing through the report we found some technical items of particular interest Thus, in testing airplanes to destruction, stress distribution is now also measured The constructor not only knows that his ship has failed under load, but where the dangerous points of stress concentration were As ships increase in speed, vibration becomes more and more of a danger, so it is logical to include vibration surveys On landing, the seaplane or flying boat takes a terrible beating so pressures on hull bottoms are under continual investigation It is good news to hear that a light, automatic pilot has been developed Perhaps this will lead to the use of the automatic pilot in private flying

The Bureau takes particular pride in the variable venturi non icing type of carburetor A meter to measure the quantity of fuel in aircraft now has the remarkable accuracy of 0 25 percent *A K*

White-Lead Paint in Colors

ANNOUNCEMENT has been made that several of the leading mixed paint manufacturers are this spring offering ready mixed pure white lead paint in colors

Both professional painting contractors and consumers will consider this departure

Modern military design in the Curtiss Falcon 22

in manufacturing procedure as good news, for the ready-mixed, pure white-lead paint in colors retains all the beauty, durability, and high protective qualities of the home-mixed, pure white-lead and oil paint. This manufacturing development now can supplement the usual practice of purchasing white-lead paste, linseed oil, turpentine, drier and mixing them on the job with colors-in-oil when tint is desired. — *C. F. Greeves-Carpenter.*

COST OF TREE PLANTING

ONE and one quarter cents is the cost of each of the many millions of trees planted by the U. S. Forest Service during 1938. The average tree cost the Service about two fifths of a cent to produce and another four fifths of a cent to plant.

More Uses for Nylon

NYLON, which was discussed in detail in our February issue, has been adapted to other uses not mentioned in that article. A new patent, just issued posthumously to the Du Pont chemist, Dr. Wallace H. Carothers, covers the use of this coal, air, and water product to coat paper, leather, cloth, and wire mesh, for making a superior patent leather; long-wearing, flexible, waterproof clothing, and a sturdy, transparent window glass.

When the chemicals, known as polyamides, are pressed into goat's leather, a new type of patent leather is produced that is more highly resistant to cracking than ordinary patent leather. They strengthen and water-proof cotton cloth. On wire mesh they make a window "glass" that transmits ultra-violet light. Many similar applications for them have been suggested.

Automatic Rifle Procurement

THE question has often been raised as to how rapidly we might equip our Army with the new Garand automatic rifle discussed in February, 1939, issue of Scientific American. At recent hearings before the Senate Appropriations Committee, Brigadier-General L. D. Gasser, Assistant Chief of Staff, disclosed the fact that early in January the Army had about 25,000 of these rifles and was getting more at the rate of about 4000 a month. He stated further that it is expected that the Army will have 150,000 by June, 1942.

To these figures, we might add the comment that this is simply peace-time production, and that in case we should go to war, production would be stepped up considerably. The one snag would be the matter of tooling up more plants for large scale production, and that, of course, would repeat the delays which we experienced in 1917 practically all along the line.

Automatic Booster Engine for Trucks

BENEFITS of vital importance to truckers, and particularly to those specializing in heavy-duty long-distance hauling — as well as highway safety advantages of a most important nature — are claimed for a new booster unit which the Clark Equipment Company has been developing over the past two years, and which has now reached the point where experimental jobs are said to be giving excellent account of themselves on the road. The Commercial Car Department of Chevrolet is co-operating in the development.

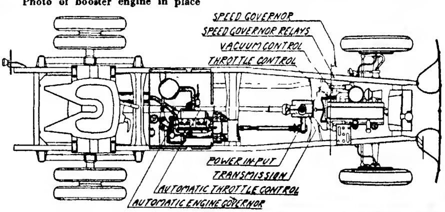
The heart of the unit consists of an auxiliary gasoline engine which automatically starts when greater power is needed for a grade, and which delivers its output to the rear axle of a 1½-ton truck or tractor through a simple and sturdy over-running clutch. Automatic starting, speed governing, and stopping are provided, the entire cycle of operation being independent of the driver.

The unit is said not only to give the medium-duty vehicle performance characteristics of units costing considerably more, but to do this without entailing the high initial outlay and high operating and maintenance cost involved with heavy-duty units. Forty-five horsepower, providing approximately 55 percent additional torque, is made available, automatically, for quicker starts and economical high-speed performance on hills.

The engine of the Clark Automatic Booster comes into use only when the main engine is unequal to conditions of road and load, and throws out when the main engine can take care of the load alone. The booster has two principal uses; to get the tractor-trailer combination up to road speed quickly from a standing start, and to maintain cruising speed once the unit is under way. An ingenious, yet sturdy and dependable system of controls not only makes this possible, but dispenses with attention from the driver, the booster being subservient to the main engine at all times.

These controls comprise a speed governor, a vacuum governor, an accelerator governor, and an automatic throttle control. In practice, these interrelated units work together to start, control, and stop the booster engine, and assure a smooth, positive flow of power from it to the transmission, when, and only when, the need for extra power exists. Each phase of the booster's operation is automatic and instantaneous, the entire cycle being completed in a fraction of the time it takes to describe it.

Above: Booster engine controls under hood. *Below:* Placement of booster in chassis. *Lower right:* Photo of booster engine in place



MILK

OWLREST'S Alice, a Jersey cow at the New York State Experiment Station, now in her twelfth year, has not only mothered ten calves but has also produced over 90,200 pounds of milk testing 5.66 percent fat.

Printing Process Freezes Ink

THE limiting factor on printing speed today is the time required for liquid ink to dry. Heat, more heat at a higher temperature, has been applied until the paper has been tried to the limits of its endurance in many cases.

A new approach to the problem of high speed printing and better printing is now offered in the form of ink and apparatus combined in a printing process which sets or dries ink by cold, not by heat. It promises to relieve the paper manufacturer of many of the problems which he now faces as a consequence of too much penetration and too much heat.

Cold-set printing is the process of drying ink by freezing instead of by absorption, evaporation, oxidation, or polymerization. All inks when dry on the paper are solid mixtures of color and binder. In the processes of printing, however, the ink must be fluid in order to feed from the fountain to

the relief printing surfaces in controlled amounts. In customary printing, this fluidity is obtained by using fluids and a fluid mixture of color and binder is deposited on the paper. This creates the printer's major problem: drying

In the oold-set process, the fluidity of the ink necessary to feed it properly from the fountain to the relief surfaces is realized simply by melting the solid which is finally wanted as a deposit on the paper. The fountain, the ink carriage steels, and the plate cylinder are all heated by hot water from within. This keeps the normally solid ink fluid and controllable. When the hot ink touches the cold paper (that is, cold as compared with the temperature of the ink) the ink freezes or solidifies without penetration and remains as a solid deposit in relief on the top of the fibers Thus the paper fibers may be loose or tight They may be uncoated or coated The cold set ink from a half tone dot, for example, always sits on top of the fibers or coating in sharp relief right where it was deposited There is no lateral spread or vertical penetration due to fiber suction as with liquid inks

Iodine Most Potent Germicide

IODINE has come through a new series of tests in which it retained its title as most powerful germ-killer, at least against such germs as those which cause typhoid fever and the suppurating skin infections such as, for example, boils. The tests and results were described by Dr A J Salle and W. A McOmie, of the University of California, at a meeting of the Society of American Bacteriologists

Of the other halogens (chemicals close to iodine, such as fluorine, bromine, and chlorine) the chlorine compounds, azochloramid and chloramine, also appeared to be highly potent germicides After these, other germ-killing chemicals were effective against the two test organisms in the following order the phenols (carbolic acid compounds), silver compounds, and mercury compounds — *Science Service.*

Motor Torpedo Boats for the U. S. Navy

FOR several years, the British and the Italian navies, and perhaps others also, have constructed and experimented with large numbers of small, high speed boats which, for operation in relatively restricted waters, possess great potentialities as defensive weapons able to administer a disproportionately powerful sting As described by Dr. Oscar Parkes in Scientific American some three years ago, they are inexpensive, carry a crew of about six men, have a range of up to 1000 miles, are exceptionally fast, are armed with machine guns, and carry a number of torpedoes. Lightly armored, their speed would enable them to escape quick destruction and it is possible that a number of them, zig-zagging toward a single target, might sink even a battleship at only a fraction of the usual cost in men and money for such a feat.

Among American naval men. it has been said that we could have no use for such boats because of our peculiarly strategic position. However, in 1936, it was felt that we should see for ourselves whether the

type had possibilities, and $15,000,000 were appropriated for experimental purposes. A design competition was held, and the Navy Department began a building program which included four 59 foot and four 81-foot motor torpedo boats plus several submarine chasers. All of these boats should be running by the end of summer.

To check our own developments, the Navy ordered a motor torpedo boat of a design by Hubert Scott-Paine, from Elco, Scott-Paine's sole licensee in this country. It was delivered in the United States in September, 1939. At that point, it became evident that it would be months before the best American type could be selected for reproduction, and the Secretary of the Navy felt that the strained international situation was such that no unavoidable delay was acceptable in the matter of commencing tactical training and experimentation, and training of personnel. As he saw it, here was a British design that had been actually proved, was reasonably good, and could be reproduced in numbers. So he at once placed an order for 23 more of the Scott-Paine design from Elco.

Purchase of such a number in one lot assures an immediate and homogeneous fleet in being without waiting until the best American design could be selected and then duplicated. Mr Edison felt that it was vital to start work with such a homogeneous fleet, and determined to speed up the development of the strategic and tactical use of the type.

While all those concerned with procurement of these boats, of a type new to the United States Navy, are interested primarily from a technical standpoint, they also look upon the present situation as a fine sporting event. Everyone is looking forward to the day when the American boats will test their worth, beam to beam, with the British design on the open sea and under the stiff trial conditions that the Navy is imposing on the new boats.

Photo-Tube Measures Ultra-Violet

A "BUBBLE" window, 0.002 of an inch thick, and a sodium cathode have been incorporated by scientists of the General Electric Research Laboratory at Schenectady in the new photo-tube shown in our

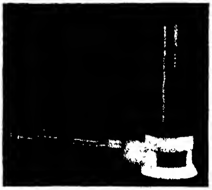
In hand: U-V measuring tube

illustration. It has a maximum response at a wavelength of about 2500 Angstrom units in the invisible ultra-violet spectrum and a very small response to visible radiation

It is made of a special ultra-violet transmitting glass and replaces a more expensive tube in a quartz bulb. Mercury vapor detection and the measurement of ultra violet output of low-pressure mercury germicidal lamps are among its applications

Illuminated Shop Microscope

TO the Flash-O-Lens which was described in these pages some months ago as a useful magnifying glass with a self contained light, there has been added a micro scope to increase its magnifying power The original device gave a magnification up to seven powers, whereas in the new Flash O Lens with the Bausch & Lomb shop micro-



scope, the power has been extended to 40 times The shop microscope has an engraved scale mounted in the body tube which reads direct to thousandths of an inch, and estimations can easily be made to .00025 of an inch

This new device, which is shown in an accompanying illustration, may find wide use in routine inspections of product and process equipment With it may be examined cracks, flaws, surface blisters, halftones, color process plates, textiles, paper surfaces, and the like. It is made by E W Pike and Company

Glass Chalkboard in Colors

A NEW chalkboard or blackboard for schoolroom and home use, manufactured from a specially treated plate glass, was announced recently by the Pittsburgh Plate Glass Company.

The new chalkboard, called Nucite, is being produced in three standard colors — ivory, green, and black — in order to give school decorators more leeway in working out color and lighting schemes. Dark chalk is used on the ivory colored "board" and light chalk on the green and black products

The development of Nucite, according to W. O. Lytle, secretary of Central Research of the Pittsburgh Plate Glass Company, was the result of an effort to provide a very durable chalkboard that would lessen eye strain of children of school age.

Nucite has less glare and its lighter colors can be used to advantage in better illumination of school rooms. Tests show that Nucite is an important contribution toward the protection of the eyesight of school children.

In addition to the reduction of eye strain, the variety of colors in which Nucite is available permits the adoption of more pleas-

ing and brighter color schemes in school rooms. Some school authorities claim lighter colors have a favorable psychological effect on the students.

LIGHT BATTERIES THAT DO NOT DETERIORATE

INDEFINITE storage before actual usage is no longer detrimental to a new emergency electric light which has been perfected by Triumph Explosives, Inc. Designed strictly for emergencies, this patented light has all the qualities of the old dry cell with the important advantage that no deterioration can take place before the light is required for use.

The new battery is similar to the standard type of lantern battery both in appearance,

Interior view of new battery that does not deteriorate. Inactive cells surround a glass vial which is shattered by striking bottom of can

Right An emergency truck flare using the battery shown above. Other forms of lamps using these batteries are designed for emergency lights at airports, in subways and mines, and so on

method of contact, and voltage capacity. The main difference is that the cells are packed and sealed in a dry state and are activated only when the bottom of the battery is struck against any solid object

Units are made up of four cells connected in series. Cells are made up of carbon and zinc similar to ordinary dry cells, except that the activating liquid or electrolyte has not been added, which is the factor that makes them non-deteriorating on shelf life When the glass or vial is broken, this liquid is absorbed by the cells which immediately activates them and then they are in every respect identical to ordinary dry cells The cells and vial of activating fluid or electrolyte are in an insulated can.

These lights are designed for emergency use in subways, mines, on aviation runways, trucks, and other motor vehicles, railroads, boats, in hospitals, and for military and marine use.

COLORS BRASS BLUE

A BLUE color can be obtained on brass by using a solution of sodium thiosulfate and lead acetate, according to *Copper Alloy Bulletin*. Suggested quantities are 124 grams of thiosulfate and 38 grams of acetate

for each liter of solution. The thiosulfate and the acetate are dissolved separately, each in a half-liter of water, and the two solutions are mixed just before use Temperature of the bath should be about 60 degrees, Centigrade A yellow-gold color is produced first and is followed by the blue in about one half minute.

INSULATION

IN placing wall insulation, it might be well to consider the statement of P. D. Close, of the Insulation Board Institute, the gist of which was that the first inch of insulation equals in effectiveness the next 20 inches.

FLUORESCENT PAINTS IN COLORS

A NEW series of 12 light-emitting paints have just been announced by Continental Lithograph Corp By ordinary light these colors have the appearance of ordinary colored lacquers, with perhaps an apparent fluorescent quality, but under the invisible glow of so-called "black light" (ultra-violet) the colors all come alive and glow in a fiery sort of beauty. The "black light," which is harmless, is generated in simple black bulbs which may now be purchased for as low as $2 each

The Conti-Glo lacquer-enamels have numerous decorative uses They are being applied in theaters for striking effects, in murals in restaurants and other public buildings, and may indeed find use in carrying out design schemes in homes

"INSTANT HEAT" SOLDERER

A NEW electric solderer recommended for all kinds of light soldering is announced by the Ideal Commutator Dresser Company Called the "Instant Heat" because it heats instantly upon touching the wire or terminal to be soldered, this tool is hardly larger than a lead pencil and easily solders in hard to-get-at places

Heating stops instantly upon taking the carbons away from the wire or terminal so that as soon as the soldering is finished the tool can be put away in the kit ready for the next job It can also be laid down without fear of scorching any article it touches.

It is safe to use because the line current is reduced by a transformer to harmless low

Just touch the point to be soldered

voltage so that there is no danger from electrical shock or burns When soldering, heat is concentrated on exact part being soldered, which eliminates danger of damaging adjacent delicate parts.

BROTHER-SISTER MARRIAGE

DISCUSSION of the case in Indianapolis where a girl is reported to have married her own brother without knowledge of their kinship revives an old question. If a scientist in the field of human heredity were asked to decide the question, "Should brother and sister marry," he would probably answer, "Well, that depends."

Ignoring for the moment all questions of law, custom, and religious taboo, and considering only the biological interest of possible children to the marriage, the geneticist would want to examine the history of the family.

If weaknesses, either physical or mental, have "run in the family," then the child of a brother-sister marriage runs a very much more than double risk of inheriting such weaknesses If, on the other hand, the family is "good stock" with many desirable traits, the child of such close intermarriage has a strong chance of receiving a valuable inheritance

The facts hold true, although in lesser degree, of the marriage of cousins

Among the animals lower than man, mating of sister to brother is common practice and is not frowned upon by biologists On the contrary, it is the method selected for building up traits most desired in future generations Man, although surrounded by complex social restrictions, is still an animal in matters of heredity.

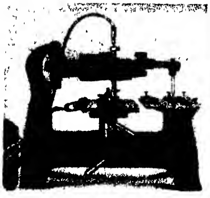
But the taboo against brother-sister marriage is pretty general in all human societies as it is in our western civilization today. Brother-sister marriages were encouraged in ancient times among royalty in Egypt, Peru, and Hawaii, but even there the common people were bound by the same taboos as elsewhere In different times and different places, the taboo is stronger or weaker, but it seems to have been universal It even extends to some sub-human animals

Yet brother-sister unions have always occurred regardless of taboos, among civilized as well as among primitive peoples This has led Dr John M Cooper, anthropologist of the Catholic University of America, who has made a special study of incest among primitive peoples, to conclude that there is nothing instinctive about the reluctance of brother to marry sister It is, he believes, purely a socially-imposed restriction. —*Science Service.*

COMBINED ENGRAVER AND ELECTRIC ETCHER

A NEW bench-type pantographic machine for general industrial engraving work on all materials, and electric etching on soft or hardened steel, has been introduced by H P. Preis Engraving Machine Company. Separate heads, quickly interchangeable, are used for the two classes of work.

On engraving work, depth of cut is controlled, independent of the depth of master characters, by a micrometer adjustment mechanism on the engraving head. Movement of the engraving cutter, to and away from the work, is controlled by a cam-action



For engraving or etching

drop lever, thus eliminating the necessity of raising and lowering the pantograph Either raised or sunk engraving can be produced For engraving on uneven surfaces, on slightly concave or convex surfaces, or on objects varying in thickness, an automatic depth-of-cut regulator is furnished

On electric marking, contact of the etching point with the work is controlled by a sensitive spring pressure The etching point may be removed from its fixture and used as a hand-etching pencil for rough or free hand marking An electrical transformer provides three or more voltage stages for various depths of marking

The compactness of this unit, and the fact that it can be plugged into any light socket for instant use, are features that should recommend it for a wide range of industrial and commercial work

AT THEIR POSTS

BELIEVED to be the first time so many employees have been reached at one time without leaving their jobs, Pontiac workmen recently were addressed by William S Knudsen, president of General Motors. The talk was made over a public address system and loudspeakers throughout the plant, the first installation of its kind

VESSELS OF MANY SKINS

THE continual increase in the pressures used in industry for gas storage, gas separation, hydraulic presses, high temperature hydrogenation, and many chemical syntheses has required an equivalent increase in strength of the vessels which are used for the processing, says the *Industrial Bulletin* of Arthur D Little, Inc. Equipment manufacturers have found that the problem could best be solved by a change in construction principle, rather than by a simple increase in the thickness of the walls of the vessel.

One promising development is the multilayer vessel constructed essentially by wrapping several thin-walled vessels around each other until the required wall thickness is attained. These vessels are now rather common and one has been successfully operated at high pressures since 1931 On service testing these vessels to destruction, the designers found that when a break finally occurred it was by stretching and deforming, rather than by explosive shattering One explanation of the success of the multi-layer

construction is that hidden flaws in the metal or the welding are confined to one layer so that a break in one layer is not followed by an immediate break in the entire vessel.

As pointed out in a recent article in *Chemical and Metallurgical Engineering*, multi layer construction is advantageous not only in strength but also in economy and flexibility of production As always with advances in equipment design, chemical engineers are already anticipating the process improvements these vessels will permit

Eye Muscle Exerciser

Weak, lazy, and inefficient eyes may be exercised with a new and versatile small-size metronoscope developed by the American Optical Company This device does two important things it aids in training one to read more efficiently and at the

". . . trains and reconditions eyes"

same time exercises weak and lazy eye muscles which do not function together

The metronoscope has three shutters in front which open and close in sequence, exposing a third of a line of words printed on a reading roll. The patient sitting before the instrument and looking through special lenses (prisms) is forced to read correctly, for the operation of the instrument does not permit long pauses or any retracings of matter that has gone before In addition, the reading roll can be speeded up, thereby training the subject by degrees to increase his reading speed. Such enforced reading trains and reconditions the eyes.

Man-Made Sunlight for Miners

An improvement on nature has been accomplished by engineers of the famous Boliden gold mine in Swedish Lapland. By means of a solarium, equipped with ultra-violet and infra-red lamps, the miners are assured of a necessary supply of life-giving — although artificial — sunrays during the six-month Arctic winter. It has successfully solved a very difficult problem, since a Boliden worker who toils under ground does not, in fact, see daylight from the middle of September to the middle of March, except during mealtimes and on his days off.

The solarium, which is free to all employees who wish to use it, is housed in a pleasant, modern building with direct connection to shower rooms and lavatories It is provided with four powerful sunlamps and four heat lamps. In order to increase

the intensity of the rays, the walls and ceiling are lined with sheets of aluminum-bronze. Through the length of the room runs a gangway between guard rails, along which the sun-bathers slowly walk. The workers use the solarium about every second day in the winter, each treatment lasting only two to three minutes, a period regarded as sufficient to provide the body with the needed amount of "sunshine."

The beneficial effects of this innovation have been clearly demonstrated in a questionnaire, which the company recently circulated among its workers Eighty-four percent of the employees reported that they were less troubled with colds than before, while some even testified that they had conquered this ailment completely. In other cases muscular aches and fatigue have been eliminated, and the number of fractures reduced In general, the sun bathers claim that they enjoy a much sounder sleep since they began the lamp treatments In addition, statistics for the winter 1937 1938 show that 175 workers had 78 fewer days off for sickness than during the dark season of the preceding years The working capacity of each individual who uses the solarium regularly also has increased.

Bohden has long been a pioneer in means and measures for improving the health and working conditions of its employees. It is now reported that many other Swedish industrial concerns, especially those located close to the Arctic Circle, will install similar solariums in their factories —*Holger Lundbergh*

Powerful Magnet Assembly

A NEW permanent magnet assembly, roughly three times as strong as any previously known, was disclosed recently by the General Electric Research Laboratory It permits a tiny piece of sintered alnico to lift and hold 4450 times its own weight.

The previous record assembly, developed in the laboratory last year, allowed a piece of the same material to lift 1500 times its own weight Sintered alnico is an alloy of aluminum, nickel, and iron as the basic or essential ingredients, and is made by pressing together the powdered metals and heat-

Magnet holds 4450 times own weight

The multi-gap magnet assembly

ing almost to the melting point. By itself, without the special assembly, an alnico magnet has a normal lifting power of 500 times its own weight

A new mounting of brass and iron in which the magnetic flux passes through many air gaps, instead of the usual two, in bridging from pole to pole, is responsible for the greatly increased power The new assembly is not a commercial development and the largest turned out in the laboratory to date contains but three cubic centimeters of alnico

Though smaller than a thimble and weighing three fourths of an ounce, this magnet in its mounting has supported as much as 200 pounds in tests

Sulfite

SULFITE liquor remaining after the cellulose is removed from wood pulp is not only an uninviting material but is also troublesome because it kills plant life and fish Yet from this unpleasant material is made sweet smelling vanillin, the basic constituent of vanilla extract, while the remaining liquor is used to make lignin plastics

NEW BIRD

DISTINCTLY surprising is the fact that despite our vaunted complete knowledge of every aspect of our country, an entirely new bird species has just been discovered. It is the first new species of bird to be discovered in the continental United States in 21 years and was found in the "panhandle" district of West Virginia by Karl W Haller, ornithologist of Bethany College.

Eyes that Shine in the Dark

THE strange light that "shines" from the eyes of cats and other animals at night has been investigated for the first time by Ernest P. Walker, assistant director of the National Zoological Park of the Smithsonian Institution.

It must be a reflection from some surface of the eye of the light that shines upon it, Mr. Walker reports in the annual Smithsonian yearbook.

Mr Walker carried out his investigation in the zoo with flashlights, aided by zoo policemen making regular rounds. While the shining of eyes is a well-known phenomenon Mr. Walker points out in his report, most of the observations have been

made in the wild. The owner of the eyes is frequently unknown, and it is usually impossible to observe the same individual again under similar circumstances.

His best results, Mr Walker reports, were obtained with light of moderate intensity. If the light is too bright the shining is less conspicuous, or does not appear at all.

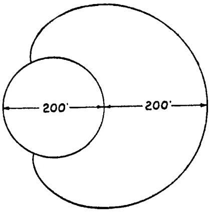
The "shines" range in color from pale silvery through silver, blue green, pale gold, gold, reddish gold, brown, amber, to pink, with a wide range in intensity from dull to very brilliant.

Mr. Walker experimented with the effects of red and blue light on the "eye shine" color of 40 species of mammals and reptiles, but he found little variation in colors of the reflected light, other than the expected red and blue tinges.

Second Circular Pasture Problem

Readers who have been addicted to Lieutenant-Commander Leonard Kaplan's mathematical problems will recall that, in his first, published last September, a cow was tethered inside a circular pasture 200 feet in diameter. This time our bovine mathematician is tied outside the same enclosure, and thus has a new problem on her mind.

A circular fence encloses a field 200 feet in diameter. A cow is tied by a rope 200



feet long to a point on the fence, and outside the enclosure. Over what area will the cow be able to graze?

Commander Kaplan suggests that the answer be published in advance, and it is 89,498.52 square feet. The solution, which is, of course, what chiefly interests the mathematician, will be published in the next number. In the meantime, send your own solutions, also any communications regarding the problem, to Lieutenant-Commander Leonard Kaplan, in care of Scientific American, 24 West 40th St., New York, N. Y., and these will be forwarded to him.

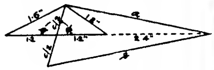
Readers who have been working on this series of problems may be interested to learn that Commander Kaplan is the Ship Superintendent in charge of the actual construction of the *North Carolina*, first of the new 35,000-ton battleships of the Navy's new building program, which will be launched in June or July. The mathematical problems represent one of his outside hobbies.

Solution to the Problem of the Medians

Last month's problem was as follows:

Construct by graphical means the triangle whose medians are 1.8", 2.4", and 3.6". Compute the lengths of the three sides of the triangle so constructed.

The solution: First, construct a triangle whose three sides are respectively equal to two thirds of the lengths of the medians. For the problem given, this will be a triangle whose sides are 1.2", 1.6", and 2.4". Draw any one of the medians of this triangle—the one to the 2.4" side, say—and produce it its own length $c/2$, as shown. Extend the side of the construction triangle to which the median was drawn its own length (2.4") in either direction. Connect the point so laid off with the extremities of the median produced, and the resultant triangle (de-



noted as having sides a, b, and c) will be the one whose medians are 1.8", 2.4", and 3.6".

Proof of the construction follows from the theorem that the medians of a triangle intersect at a common point, which trisects each median.

Since 1.6" completes the triangle, whose other two sides and the included angle are 1.2", $c/2$, and θ respectively, we may write the following relation,

$$(1.6)^2 = (1.2)^2 + \left(\frac{c}{2}\right)^2 - (2)(1.2)\frac{c}{2}\cos\theta \qquad (1)$$

and similarly, for the triangle where 1.2" is the side opposite the angle φ included between $c/2$ and 1.2",

$$(1.2)^2 = (1.2)^2 + \left(\frac{c}{2}\right)^2 - (2)(1.2)\left(\frac{c}{2}\right)\cos\varphi \qquad (2)$$

Adding (1) and (2) gives

$$(1.6)^2 + (1.2)^2 = 2\,(1.2)^2 + 2\left(\frac{c}{2}\right)^2 \qquad (3)$$

from which,

$$c^2 = 2.24$$

and

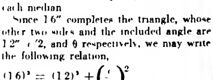
$$c = 1.49666''$$

We may solve for the other two sides in the same way. They evaluate to

$$a = \sqrt{11.84} = 3.44093''$$

$$b = \sqrt{15.20} = 3.89872''$$

A second method of graphical solution is shown in the second sketch. Here, the first step is to construct the triangle of the me-



dians—the triangle, that is, whose sides are 1.8", 2.4", and 3.6". Next, lay off progressively—from left to right, say—two thirds the length of each of the sides of this triangle. The triangle connecting these points will be similar to and will have sides one half those of the triangle desired. The latter can be produced graphically by drawing through each vertex of the half scale triangle parallel to the side opposite.

YOUR FIREARMS

Conducted by A. D. RATHBONE, IV

INTEREST IN FIREARMS *is traditional with American men, science has so developed them that millions yearly find sport and recreation in their use. Hence this monthly department presenting a wide variety of discussion regarding firearms, their handling, and their accessories. Suggestions from readers will be heartily welcomed.*—The Editor.

"Caviar" Guns, and Others

THE fine art of engraving on guns is almost as old as firearms themselves, but modern engravers are said to surpass the 16th Century artisans in skill, imagination, and execution. Since the days of Simon and Pedro Marcarte and Albrecht Durer, tools of the trade have improved a thousand fold, which no doubt accounts in large measure for present-day excellence in artistry. Despite endorsement of the Marcarte brothers' art by Holy Roman Emperor, Charles V, the appointment of Pedro Marcarte as Royal Arquebusier to Charles II of Spain, and notwithstanding Durer's unimpeachable reputation as painter and engraver, the picture of the late 17th Century

Courtesy International Studio Art Corp

From the 17th Century

Italian-made flintlock, reproduced here, indicates that although European gunsmiths had by then plied their trade more than 200 years, the decorative art and its delineation was crude, unimaginative, and lacking in perspective and depth, as compared with the modern work of Joseph Fugger, for example.

The infancy period of firearms history might be termed the "Age of Caviar and Kippered Herring," for the ornate and inlay work, which often covered the entire weapon, meant as much to the medieval huntsman as the utility of the piece and so increased its costs as to prohibit ownership by any save kings and noblemen. If the medieval vassal owned a gun at all, it was a plain, simple affair with shooting proclivities probably on a par with that of his feudal lord and master, but it was conspicuous for the absence of designs and decorative effects. Today, while the taste for "caviar" guns has improved and increased, rather than diminished, the "kippered herring" class of firearms is being served up with a bit of toast, so to speak, and, to carry the fancy further, frequently with butter and a garnish of parsley.

But this doesn't mean that the cost of beautiful engraving has decreased, as indicated by the price for a truly amazing and intricate pattern of relief work in gold and silver on a Smith & Wesson revolver, recently completed by the firm of Griffin &

In gold and silver

Howe, New York. The job required almost a year of working hours on the part of Joseph Fugger, Griffin & Howe's ace engraver. While this piece is considered by S. R. Griffin to be one of the finest ever turned out in the 17 years his firm has been in business, the constant flow of orders for firearms decoration from all parts of the country frequently brings commissions which keep Joe Fugger on the same weapon for 100 to 150 hours.

The name of Rudolph John Kornbrath will be familiar to many owners of beautifully engraved guns, for during his hey-day he was acknowledged as America's No. 1 firearms engraver, and it was Kornbrath who enticed Fugger to this country after the latter had completed a four-year course in engraving in his native Austria. Kornbrath, an earlier graduate of the same Austrian school, took the younger man into his shop in Hartford 16 years ago as apprentice. From there he went to Griffin & Howe, for whom Kornbrath had frequently done special work. Today, Fugger, whose father before him was a noted Austrian gunsmith, is the acknowledged suc-

Of the 20th Century

Hands that do the work

cessor to the master, Kornbrath, who has been forced into retirement by ill health.

Fugger, according to S. R Griffin, is typical of the skilled artisans who are products of English, Austrian, Belgian, Swedish, and German training in gunsmithing Contrary to American mass production methods of firearms—necessary to supply our 8 million licensed hunters—the Europeans still adhere to the "custom made" theory of sporting gun manufacturing to a greater extent

Machine manipulated

than do we. Because of the high quality of workmanship demanded by his clients, Griffin, therefore, has found it advisable to staff his shop entirely with European trained workmen, all of whom, incidentally, are naturalized American citizens.

However, this is no diatribe against our own firearms manufacturers, whose inventive genius, perspicacity, and business acumen are responsible for more improvements in firearms since America's cradle days than all the rest of the world put together. As stated above, mass production in the U. S. A. is necessary to supply the demand, and the fact that our manufacturers have not only accomplished that, but also have incorporated in their products many refinements and niceties found in European "tailor-made" guns, speaks volumes. It took American ingenuity to find methods of serving up the "kippered-herring" gun with "toast, butter, and parsley." And just so we won't be misunderstood, our personal gun rack contains an $8.95 single barrel, 16-gage shotgun which has accompanied us through numerous vicissitudes, and if you don't think it's valued highly, try to get it out of our den.

Typical of American efforts to enhance medium priced shotguns is the newly perfected electric etching process of the J. Stevens Arms Company. Machine manipulated, and directed in accordance with the lines of a pre-determined master pattern, this process produces in exact detail on gun receivers any scene depicted in the original specimen. Although full description of this etching process remains a secret, it can be told that the method provides a means of making changes in the pattern at very reasonable cost so that the same scene or decoration need not appear on all products A further variation exists in the reversal of the process to bring out the image in relief.

Of course, kippered herring may never hope to attain to the status of caviar, and it hasn't been our intention in this column to intimate that we think all shotguns or rifles are the same under their etchings There are just as many differences between the well made, straight-shooting, $9 single barrel (like our's) and the magnificently constructed $1000 piece (which we don't own!), as there are between any other manufactured products with a wide price variance. The point is that, under the American system, those of us who have "kippered herring" incomes can shoot just as well and have just as much fun shooting as anyone else.

Pot-Shots

AT THINGS NEW

The Dairy Specialties, Inc., announce the "Ferret" shotgun cleaner, made to fit any standard cleaning rod and all gun gages. Composed of a bronze alloy wire, soft enough to prevent gun-barrel injury, yet hard enough to remove rust, lead, other deposits, the "Ferret" is tapered at both ends to permit passing through choke in both directions, on rod or stout cord, and is self-sharpening, working even better after being used a few times. It sells for 65 cents.

Books of the Moment include "A Handbook of Salt Water Fishing," by O. H P. ("Ollie") Rodman, Editor of "Hunting and Fishing," and "Mastering the Rifle," by Morris Fisher, National, International and Olympic Champion.

The Poly-Choke Company offers for 1940, in addition to their well-accepted device for producing nine different degrees of choke on automatic or repeater shotguns, the "Aero-Dyne" Super Poly-Choke, especially adapted to the new, crimp-top shells. The new product produces a more open pattern than the regulation wide-open bore and is available for 12, 16, and 20 gage shotguns. All Poly-Choke products are described in new, free booklet, "How to Become a Better Wing Shot."

Francis Bannerman Sons are celebrating their 75th Anniversary with a new and larger catalog of 287 pages, plus index and appendix. This comprehensive volume, devoted to war relics, ordnance, antique firearms, military goods of all kinds and description, is as authoritative a book as is published on these items. Catalog sells for 50 cents; is worth many times the price.

Conducted by JACOB DESCHIN, A.R.P.S.

Lighting Goes Miniature

THE ability to create special lighting effects with equipment that can be handled with ease in the average home and has, in addition, the advantage of portability, is something that most serious photographic workers desire The selective lighting so characteristic of spotlights is particularly in demand Recently, some succesful ventures in this connection have been undertaken by enterprising manufacturers to bring to amateur as well as professional workers, so-called "miniature spotlights" that, in our opinion, provide all the lighting facilities necessary for many types of pictures, whether "straight" or otherwise.

Figure 1

Figure 2

Those at present available are usually equipped with a Fresnel lens, which gives a soft outline to the spot, a small projection bulb corrected to 3200 degrees, Kelvin, the temperature required for color work, a control lever for varying the size of the projected beam, adjustability of the light ing angle, and a base that can either be set on a table, floor, or similar support, screwed into a tripod head or, by the use of an accessory adapter, attached to a regular light stand.

Among the miniature spotlights now available, or soon to come on the market, are the Dinky Inkie, now being used extensively in Hollywood studios for special portrait effects, the F-R Hi Spot, and the Lafayette Hi-Lite Another type of miniature spotlight is the Willo Spotlight which uses a Photoflood bulb and a condensing lens to provide a small, bright spot

Among the uses for which this type of equipment seems particularly adapted, there at once come to mind still lifes, table-tops, and portraits By controlling the beam, either through close approach to the subject, the use of a "snoot" as on the Dinky-Inkie, or varying the distance between the spotlight lens and the bulb, one may illuminate small areas and thus place light emphasis where it belongs

Figure 3

The versatility possible with these miniature spotlights, when equipped with diffuser and snoot, is demonstrated in the result shown in Figure 1, which was lighted with two Dinky-Inkies. One unit was placed in front, near the camera, with diffusing screen before the lens, while the other, equipped

Figure 4

with a small diameter snoot, was set at an angle to the subject. The result shows a definite spotlight effect on the selected area (the face), with shadows filled in by the front diffused light These snoots are available in various diameters In addition, one may obtain a set of "barn doors" or blinkers to keep light away from unwanted areas of the subject matter Figure 2 illustrates a more or less "straight" portrait lighted as shown in Figure 3

These spotlights are a particular joy to the tabletopper and those workers who take a delight in still life photography Figure 4 shows an F R Hi-Spot in use on a tabletop subject The ease with which these lights can be handled is obvious to anyone who has had experience with larger equipment Because of their small size, they may be placed in out-of-the-way corners, even behind the subject, and at all sorts of angles

To provide a general light, the lens may either be fronted with a diffusing screen or, where a stronger light is wanted, the lens may be removed entirely and the bulb moved forward as far as it will go A surprisingly large area can be covered in this way This all-round usefulness of the miniature spotlights brings the suggestion that one might assemble a complete lighting outfit by using three miniature spot lights, provided with three light-weight stands. For these, a fiber case might be made to house the entire equipment Such a combination, with its extreme portability, would not only allow the worker quickly to assemble or dismantle his lighting equipment for storing in a closet, but would also permit taking the whole affair to distant scenes of picture-making

A New Profession

COMMENTING on the scarcity of photographers who at the same time have a background of scientific training in a special field, Fairfield Osborn, Secretary of the New York Zoological Society, proposed a new profession at a recent Conference on Photography, held in New York City under the auspices of the Institute of Women's Professional Relations, Connecticut College He suggested that there should be a fruitful field for young people in a thorough training in a specific field of science, going hand in hand with a thorough training in motion pictures or still photography, towards the end of achieving the ability to interpret science for the layman.

The man who "knows his stuff" is always in demand and the photographer who has a good knowledge of the subject he is photographing, and therefore interpreting, is hard to find As an example, Mr Osborn pointed to the fact that for some time his organization has been looking for a good motion-picture photographer who had also had a good training in zoology, and that so far the search had been in vain.

Colonel Edward Steichen, the photographic ace of our time, addressing the same group, referred to photography as "the universal medium of expression" Differentiating between the amateur and the professional, Colonel Steichen said that the amateur, even though he may sell a photograph now and then, may still keep his amateur status because he works only as the mood moves him, whereas the commercial photographer must turn out pictures as and when ordered The news photographer, he added, has a still harder job because, although the commercial photographer, even though working against a deadline may have opportunity to shoot 50 or 100 negatives, the news photographer must bring it all in on one plate

Speaking of the financial reward in photography, Colonel Steichen said that if a man or woman goes into the field with the idea of making a lot of money, he or she had better forget about it right away All the aces in photography, he said, started off with the idea of turning out a good picture, but not to make money That they also made money was incidental

We should like to comment here that while the photographic field is overcrowded, as Colonel Steichen said, so is many another field, but for the person with superior ability and a new idea, there is always room in any field, and that includes photography

In our next issue, we plan to give a resumé of the various talks given during the Conference, in which speakers from many different fields outlined the opportunities for photographic careers.

Prize Winners

PRIZE winners in three amateur photographic contests have been announced since our last issue. These took top place in the Raygram Corporation's Ray Del Developer Contest, the third annual Kalart Speed Flash Competition, and the Packard Amateur Photo Contest

The first contest, which called for pho

First Prize: Field

Second Prize: Steinmetz

tographs illustrating the idea of balance, and made from negatives developed in Ray-Del, was judged by Willard D Morgan, Kip Ross, and Herbert C McKay. Prize winners were Nathaniel Field, Brooklyn, New York, who took first prize of $50, Joseph Janney Steinmetz, Philadelphia, Pennsylvania, second prize of $25, and Edmund Janke, Jr., Middletown, Connecticut, third prize. Nine others received honorable mention and cash awards of $5 each

Twenty-five entries, representing practically every section of the United States, won cash prizes totaling $250 in the third annual Kalart contest. More than 2000 prints were received, a 130 percent increase over last year's contest. Subjects ranged from the familiar child pictures to spinning gyroscopes.

Murray Hoffstein, of New York City, employing a recently purchased Automatic Rolleiflex, took first prize in the Packard Amateur Photo Contest. The picture he

Packard winner

made and the car he won are both shown in the accompanying illustration. Shortly after the judging was completed and the winners were announced, Mr. Hoffstein rolled away in his new "One-Ten" Packard convertible coupe. The judges found the picture pleasing from both the artistic and the illustrative angles.

New Solar Models

IMPROVED models of the Solar enlarger are now available possessing a number of features designed to make them adaptable to various uses other than straight enlarging. The enlarger, which comes in three models covering all negative sizes from 35mm to 2¼ by 3¼ inches, now permits easy adjustment of the equipment for ver-

tical or horizontal projection; for use as a copy stand, employing your own camera; for straight photography and photomicrography, and other needs. Lenses and lens boards are interchangeable, and the lamp house may be used as a lighting unit in tabletop and similar work.

Hypo Caution

ORDINARILY, the mixing of a hypo solution is by no means a critical proposition. However, if—through neglect or through some notion that, by making the hypo bath stronger, fixing will be more rapid or more effective—the formula is not followed, it will sometimes be found that the strong hypo solution will tend to bleach the image

We Make The Millionth

THE nearest we shall ever get to a million of anything is reported in a story in the Kansas City Star announcing that our recent book, "Finding New Subjects for Your Camera," was the 1,000,000th book added to the Kansas City Public Library The event was marked by the publication of a picture showing a library staff member stamping the number in the book The story adds that the book arrived 66 years to the month from the beginning of the public library and that the book which had been numbered 1, "The American Cyclopedia," was long since worn out and discarded

The library, the story adds, possesses more than 100 titles on photography and, as indicative of interest in the field, the file cards are soiled with thumb marks

"We can't find enough books on the subject," said Louis Nourse, the librarian

Metal Alloy For Sinks

WHAT'S good enough for the professional is good enough for the amateur photographer. One of these is a metal known as Inconel, 80 percent nickel and 20 percent chromium If you are looking about for a metal darkroom sink that will with stand the corrosive tendency of photographic solutions, we would suggest your investigating Inconel We have been advised that it "stops fogging, metallic contamination, corrosion, chipping, cracking, and rusting," and that as a result it is being used extensively in the processing of motion-picture film, as well as in some large photo-finishing plants Also, photographic trays made of this metal are available in various sizes.

Enlarger Prices Down

PRICE reductions on all models of the Praxidos and Bee Bee Enlargers are announced by the distributors, Burleigh Brooks, Inc The prices have been cut as much as 42 percent in some cases.

Stolen Cameras

THE wave of camera thieving goes on apace. Every once in a while we hear about another member of the photographic fraternity whose studio or home has been broken into by thieves and robbed of expensive cameras and equipment. Recently,

the thieves have made several large "hauls" These losses are seldom recovered and when they are it is usually in a pawnshop

With thieves gunning for cameras and equipment, every owner of cameras having reasonably high value should guard his equipment by using strong locks, never leaving the equipment carelessly about and, above all, taking out camera insurance If insured, at least you have the feeling that your camera is protected—even against your own oversights!

Cold Light In Darkroom

With fluorescent lighting as one of the big features of the day, the introduction of a new type enlarging lamp that employs a fluorescent gaseous discharge tube makes interesting news The unit, known as the Princeton Fluorescent Enlarging Lamp, comes equipped with a light equalizing screen and is no more trouble to install in the enlarger housing than the ordinary light bulb The makers claim that the unit is "so cold that it can be held in the hand after ten hours continuous operation with no discomfort whatsoever"

The unit produces white light "extremely close to daylight in its color characteristics" It is reported that the unit "provides a soft, white light evenly diffused, which gives a peculiarly fine print quality which combines tonal gradation with true brilliance"

Using alternating current only, the unit has a minimum life of 2000 hours It consists of a small metal housing 4 inches high and 3¾ inches in diameter, fitted with a standard screw plug that fits the socket of the enlarger The light may be used for all negatives from 35mm up to 3¼ by 3¼ inches The unit is adjusted so that the diffusing screen is close to the upper condenser face

Printing Harsh Negatives

The best way to correct harsh negatives is not to make them in the first place, but having made a harshly lighted negative, here is one way of making the best of the situation Place a piece of ground-glass of the right size next to the emulsion side of the negative and project or contact-print through the negative. The ground glass,

coming between negative and paper, will break up the direct rays of the light and cause a light dispersion that will bring about the desired diffusion, avoiding abruptness between the shadows and strong highlights.

Chromium Tin Distortion

CREATED simply by bending a chromium tin and photographing the tin reflection at an angle, "Something New in Headgear," may provide an impulse for

"Something New in Headgear"

working out comical notions The distortion effect achieved depends on the subject used, the degree to which the tin is bent and tilted, and the camera angle The tin is held rigid in any given shape by the use of string on each side

This is one of a large number of tricks, comprising a sort of "trick encyclopaedia" included in a little book on trick photography by "yours truly," soon to be published

Cleaning Trays Overnight

IF you have your own darkroom, sink and all, here is a tray cleaning tip that has been handed on to us by an old timer After a day's work he pours the stop bath into the emptied developer tray and leaves it that way overnight When he comes in the next morning, he tears a sheet from his newspaper before walking into the darkroom and, after emptying the stop bath from the developer tray, crumples the newspaper and uses it to wipe out the thin layer of sediment on the bottom and sides of the tray. The tray is then thoroughly washed before use.

Washing Roll Film In Tray

IN these days of film developing tanks, which serve for developing, rinsing, and fixing, plus washing, the "see saw" method of developing film rolls in a tray is rather passé. However, there are doubtless many persons who still do not own tanks; also there may be some who would not have one as a gift but prefer the old ways to the new On the other hand, it may sometimes be found convenient to develop see-saw fashion in a tray At any rate, if and when you do, here's a washing tip Form the film into a horizontal circle with the emulsion (now negative) side out Overlap the ends and fasten them with a pin or clips So joined, the film will stand on edge and will be washed clean of hypo in 20 or 30 minutes.

WHAT'S NEW
In Photographic Equipment

If you are interested in any of the items described below and cannot find them in our advertising columns or at your photographic dealer, we shall be glad to tell you where you can get them Please accompany your request by a stamped envelope

KODAK FLASH SYNCHRONIZER ($7 50) For use with current model Kodak cameras having shutters accepting cable release Battery case of black molded material holds two 1½ volt cells Lamp socket, of quick action type with four springs, holds No 7, 11A, 16, or 16A Photoflash lamps in correct position in front of highly polished spherical reflector Housing on side of battery case contains operating plunger, adjustable switch contact, and container for head of cable release Cable releases to fit cameras with which Kodak Flash Synchronizer are to be used must be purchased separately Longer cable release necessary for some cameras than ordinarily used Recommended procedure set for bulb exposures May be adjusted to 1/50 of a second shutter synchronization. A 2½-volt lamp, miniature socket, cord and plug to fit lamp socket in battery case, plus instructions, supplied for this purpose Camera is attached to metal camera support bracket by large knurl-headed screw fitted in camera's tripod socket Battery case of synchronizer attached beside camera on same bracket

FEDERAL ENLARGER MODEL 440 ($27 50) Takes negatives from 35mm to 2¼ by 3¼ inches and intermediate sizes Supplied with $f/6$3 anastigmat lens Features condenser lens and illuminating system includes 4½-inch condenser lens and ground diffusion plate and special parabolic reflector, convertible glass or dustless metal plate negative carrier, new adjustable metal mask, quick-acting clutch, double spiral focusing, lens mounted with click diaphragm and built-in red filter, cool lamp housing, 36-inch steel upright post mounted on heavy 16 hy 22-inch hardwood base board Accessories included projector lamp, underwriters' approved control switch, cord, and plug Works on AC or DC

RAYGRAM BOX TYPE BEADED SCREENS ($10 to $20). Made of Dupont screen cloth, with coated back and beaded with graded blue white glass beads Important feature semi-automatic frame When screen is pulled out of case, it automatically stands erect Slight pull on release cord all that is necessary to close it Made in four sizes.

PERFEX FIFTY-FIVE ($39.50, $49 50) Latest addition to Perfex line of miniature cameras. Supplied with $f/3$5 or $f/2.8$ lens. Features same as Perfex Forty-Four, plus

following improved focal plane shutter mechanism Slow speeds—bulb, 1, ½, 1/5, 1/10 second independently controlled by dial located at front of camera Rewind lever replaced by button, which disengages film transport mechanism and eliminates any possibility of tearing film sprocket holes when rewinding

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Gem Transparent Photo Colors (25 cents per package): For painting and tinting photographs. Eight different colors packed in small folder. To use, simply tear small strip from colored sheet and place in water Supplied with folder are small cotton sticks which are used as brushes

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Para Filters Combination sunshade and filter set. Base arranged on revolving lens flange, slotted to permit insertion or removal of filter, a half turn of sunshade opens or closes slot. Designed to slip over regular camera lens. Two types of mounting available one having set screw, other with six spring tension points which grip lens barrel Set complete with five color fused optically flat glass filters, light yellow, medium yellow, orange, green, and red. Heavily constructed, chrome-plated Instructions supplied covering filter factors for five filters in either day or artificial light, with information on type of film.

Federal Enlarger Model 246 ($49.50) · Takes negatives from 35mm to 2¼ by 3¼ inches and intermediate sizes. Complete with $f/4.5$ anastigmat lens. Specifications. double extension bellows (takes lenses from 2-inch focal length to 5 inches), double condenser lens system, enlarger convertible to condenser or diffusion illumination or combination of both, opal lamp on adjustable slide, with special parabolic reflector, supplies even light distribution, convertible glass or dustless metal plate negative carrier, new adjustable four slide metal mask; dustless metal negative pressure plates; negative pressure release permits negatives to be removed while in machine without scratching, micrometer focusing control; four-element 3½-inch $f/4.5$ anastigmat mounted in removable lens board, counter-balance adjustment; double ventilation radiation fans in lamp housing, rigid steel 36-inch upright post mounted on heavy 16 by 22-inch baseboard; enlargements from 1½ to more than 8 times on baseboard with 3½-inch lens, greater by projecting on floor, enlargements up to 18 times on baseboard with 2-inch lens Accessories included large red filter, 75-watt opal enlarging lamp, focusing target, approved cord and switch. Works on AC or DC.

Raygram Rubber Darkroom Apron ($1) Made of rubber-coated fabric, light in weight but durable. Unique feature trough at hem to catch any hypo or developer that might otherwise stain shoes or clothing. Breast pocket provided for carrying thermometers, pencils, and so on

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Filmoleen · Cleaning fluid for color film and black and white. Removes slight surplus of dye from surface, giving yellowish tinge to cleaning cloth, but not affecting the colors. After first tinge of color is removed, it is said, subsequent cleanings with Filmoleen have no further effect of this sort.

CAMERA ANGLES ROUND TABLE

JACOB DESCHIN, *conductor of our "Camera Angles" department, will answer in these columns questions of general interest to amateur photographers. If an answer is desired by mail, enclose a stamped, addressed envelope. Queries should be specific, but Mr Deschin cannot undertake to draw comparisons between manufactured products nor to advise on the purchase of equipment or materials* —The Editor.

Q. Can you advise me about taking snapshots indoors in daytime with light from windows and doors? I usually use orthochromatic film.—C. M. M.

A One of the fast panchromatic film emulsions would be more suited to this purpose, especially where it is necessary to keep exposures at a minimum, as in the case of portraits An extinction type exposure meter will frequently be more useful in taking indoor readings than the photoelectric type Of course, the reading should be made from the shadow side in order to make certain that shadow details, where wanted, will be recorded In making snapshots of persons indoors by daylight, have the subject seated a couple of feet or so away from the window rather than close to it, and at an angle of 45 degrees to the light coming from the window For the shadow side, provide a reflector of some sort to catch the window light and throw some of it into the shadows A newspaper or pillow case, for example, will do In taking interiors, the lightness or darkness of the walls and furnishings will make a considerable difference in the required exposure.

Q. Will you please tell me how I may treat my table so that hypo and developer will not harm the paint?—H. S. McC.

A. An efficient protective covering would be a strip of linoleum or sheet rubber. Oilcloth has been used, but this is usually too thin, cracks easily and is generally not very reliable if you are particularly anxious to protect the paint on your table.

Q. I would like to make some money with my camera hobby. Would you recommend some books? What is the best way for someone living out here in the Far East (Java) to make contacts with the right people. I have a lot of pictures about mountain trips, trips to the seacoast, the natives, and so on. Some of them have been accepted by local illustrated papers.—W. A. C.

A. Among several of the more popular books on the subject are "Camera Journalism With the Miniature Camera," by George W. Hesse; "Free-Lance Journalism With a Camera," by Rufus H. Mallinson (an English publication); "Making Amateur Photography Pay," by A J. Erickson, and "Where and How to Sell Photographs," by H Rossiter Snyder. A valuable guide to markets is the Universal Photo Almanac and Market Guide Probably the best way to make market contacts for a person in your situation is to deal through a reliable picture syndicate. A long list of these is included in the Almanac's market guide, the current (1940) issue of which also contains some articles on the subject of making money with the camera.

Q. Is 35mm Kodachrome obtainable unnotched? What is the finest fine-grained black and white 35mm film obtainable?—F. C.

A. To our knowledge, all 35mm Kodachrome film is notched both for the purpose of fitting the sprockets of miniature cameras and to facilitate processing in Rochester Several film manufacturers make what they claim is tops in fine grain; we would suggest, therefore, that you make tests with the various films and settle the matter for yourself

Q. Would you kindly inform me of some authoritative source of information on the reversal process for cine film? Also, I would like to know where I can get hold of 16mm film without paying the processing price at the same time.—N. G. A.

A. "Motion Picture Laboratory Practice," published by the Eastman Kodak Company and "Home Processing," by P. W. Harris, are reliable texts on this subject. Of course, you know that positive film can be purchased but this will have limited possibilities. At the present time 16mm motion-picture film cannot be purchased without paying the processing charge, but it is expected that the Gevaert Company of America will shortly have available movie film for home processing.

Q. I would like to know the formula for a film cleaning solution containing ethyl alcohol.—R. S. J.

A. Here it is, thanks to the "Leica Manual":

Ethyl alcohol (pure grain alcohol)	85%
Methyl alcohol (wood alcohol).	10%
Strong ammonia	5%

The solution is applied to both surfaces of the film with a clean, lintless fine linen cloth, soft chamois, or lens tissue.

OUR BOOK CORNER

THE Book Department of Scientific American is conducted, with the co-operation of the Editors, to make available for you a comprehensive book service. Each month the Editors select and review in these columns new books in a wide range of scientific and technical fields. In addition, they are ready at all times to advise you regarding the best available books on any subject. You are invited to use this service freely. Tell our Book Department what kind of books you want and you will be furnished with a list of available titles, including prices. When inquiring about books, please be specific; remember that we can be of the greatest help only when you tell us just what you are looking for.

THE MICROSCOPE

By R. M. Allen

MICROSCOPIC methods have shown their utility in the greatest diversity of fields. Partly this has resulted from the ingenuity of users in applying it to new purposes and partly from the increasing convenience of the improved products of the instrument makers In devoting a large section of the book to descriptions of instruments, the author makes opportunities to guide the user in manipulative methods, which with accounts of available accessories occupy most of the book Particularly aimed at the layman, the book's treatment will be of great value to experts in specialized fields who are called upon to work outside their specialties (VII—286 pages 6 by 9¼ inches, 82 illustrations in text and 18 full page plates) $3 10 postpaid —*D. H. K.*

MASTERING THE RIFLE

By Morris Fisher

POSSESSION of three world's Championships, the Olympic Individual Championship and dozens of other rifle marksmanship honors, places the author, a member of the United States Marine Corps, in a position to lend authority to his work which deals with sight adjustments, firing positions, use of the sling, breathing, trigger squeeze, wind allowances, 'scope sight elevations, choice and care of a rifle, and many other items of importance to both beginner and experienced shot For the new rifleman, the procedure of shooting is carefully outlined with a view to assuring prompt results (206 pages, 8 by 5¼ inches, 26 line drawings, 14 photographs)—$2 60 postpaid.— *A D R., IV.*

GRAPHIC GRAFLEX PHOTOGRAPHY

By Willard D Morgan, Henry M Lester, and 20 other contributors

THE editors, whose names have for some years been associated with miniature photography, now bring out a book for the "big camera" enthusiasts. (Whatever may be the pros and cons concerning miniature photography, there is no doubt that the large camera is making a definite comeback) Subjects covered include negative exposure and development, advice on how to choose a lens, how to use filters, practical guidance on successful printing methods, synchroflash photography, and lighting control. How to use a view camera is covered as the first modern treatise on the subject Kodachrome photography is fully treated. An important chapter deals with the photographic darkroom (416 pages, 7½ by 10 inches, hundreds of illustrations) — $4 10 postpaid —*J D*

LOVE PROBLEMS OF ADOLESCENCE

By Oliver M Butterfield, Ph D

ROMANTIC interests and love problems of a homogeneous group of 1500 American youths between 13 and 25, distributed over the nation, were the objects of this research The youths, including girls, came to the author and discussed their troubles almost without inhibition The book reveals the minds and attitudes of the present younger generation but is more in the nature of a sociological study than a practical work of advice (212 pages, 6 by 9 inches, unillustrated)—$2 35 postpaid —*A G I.*

PERSPECTIVE MADE EASY

By Ernest R Norling

DRAFTSMEN and artists supposedly learn perspective early in their studies, but actually a surprising number of them know scarcely more than the fundamentals This author has attacked the problem in such a simple fashion that a complete knowledge of all the rules of perspective may be easily grasped Progressively the author takes up the various details of perspective from simplest forms to complicated and unusual figures—roofs, furniture, and the like. (203 pages, 5¾ by 8½ inches, copiously illustrated with drawings)—$1.85 postpaid. —*F. D M.*

NATURAL HISTORY OF THE BIRDS OF EASTERN AND CENTRAL NORTH AMERICA

By Edward Howe Forbush, revised and abridged by Dr. John Bichard May

ORIGINALLY compiled in 1925 in three volumes by Mr Forbush at the instigation of the Commonwealth of Massachusetts, the present condensed publication was prepared by Dr May under the direction of the Massachusetts Audubon Society. Dr May, who assisted in the initial compilation, has included 530 species of birds in the present book, an increase of more than 100 over those shown in the original three-volume work The 97 four-color plates are from original paintings by **Louis Agassiz Fuertes, Allan Brooks, and Roger Tory Peterson. Two indices, one of scientific and one of common names, are cross referenced with both text and illustrations This is undoubtedly one of the finest of bird books, worth several times the price asked (554 pages, 7¼ by 11¼ inches, 97 color plates.)—$5.05 postpaid.** —*A.D R, IV.*

STARS AND MEN

By Stephen A and Margaret L. Ionides

THOUGH it is about astronomy, this is neither a textbook nor a systematic popular coverage of astronomy; it is a collection of discussions, entertaining and readable, of things astronomical, largely of historical nature Typical subjects are the design of the pyramids, early sundials, the astrolabe, the cult of the solstice, sun symbols and their origins, reasons for naming the constellations, laughing the astrologers off the face of the earth, the calendar, planets, stars, comets, and very many others In short, a fine collection of astronomical lore that is otherwise difficult to look up Written by two Denver amateur astronomers (460 pages, 6 by 9 inches, about 70 illustrations)—$4 10 post paid —*A G I.*

A SHORT HISTORY OF THE STEAM ENGINE

By H W Dickinson

FROM the early but ineffective efforts of several experimenters, through Savery, Newcomen, Watt and on up, and through the low pressure and high-pressure engines of the first half of the last century, also the land boilers of the same period, and up to the present the author conducts the reader. He knows his engines as well as his builders, and can talk engines correctly—is not just a rewrite author He is the accepted biographer of Watt, Boulton, and Trevethick and has spent 30 years in contact with his subject Part II of this book is a history of the steam turbine (255 pages, 6 by 9½ inches, 78 illustrations)—$3 60 postpaid.— *A G I.*

A HANDBOOK OF SALT WATER FISHING

By O. H P Rodman

REALIZING the salt-water angler's long felt need for a ready reference library condensed to pocket size, yet replete with detailed information on this many sided sport, the author has compressed the knowledge acquired from his years of fishing between the covers of this volume in an attractive and absorbing style It covers all common species of salt-water fish, presents connotations on each as to synonymous names, range, habits, seasons, fishing

We can supply our readers with any of the books reviewed in this department. Prices quoted include domestic postage. Foreign prices are necessarily higher due to increased shipping charges.

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FOR OTHER BOOKS YOU WANT, SEE PAGES 228 AND 244

methods, recommended tackle, food or sport value, size and catch records. How, where, and when to angle for all kinds of salt-water denizens is well and interestingly told for the benefit of both neophyte and expert. (274 pages, 4¼ by 6¾ inches, 37 line drawings of fish, 19 of tackle items)—$1.85 postpaid.—*A. D. R, IV.*

THE PHILOSOPHY OF PHYSICAL SCIENCE

By Sir Arthur Eddington

THOSE who enjoy Eddington's philosophy as previously set forth in smaller pieces will find here a good big chunk to chew on and, unless they are a bit above average in masticating ability, they will find it tough chewing. In fact, he says so himself "Some parts of the book introduce matters of considerable technical difficulty." It is not, however mathematical, at least it avoids formulas. A fuller title for the book might have been "The Nature of Physical Knowledge, with Application to the Physical Universe." He calls his philosophy "structuralism," or "subjective selectivism." Epistemology is the subject largely dealt with (230 pages, 5½ by 8½ inches, unillustrated)—$2.60 postpaid—*A. G. I.*

CAMPS AND COTTAGES—HOW TO BUILD THEM YOURSELF

By Charles D. White

JUST the book for the man who can use woodworking tools moderately well and about half understands the principles of house construction. It supplies the other half of the knowledge of such things as how to assemble a simple building (neat sketches of correct construction), plan and execute the trim, lay out the roof, and other items. It is a crutch by means of which the average man can put up a neat, correct, $400 or $500 or $700 camp cottage himself (saving several hundred dollars thereby) without risk that a real carpenter will grin when he sees the job. Practical chapters deal with materials, tools, roofing, fireplaces and chimneys, paints, water supply, and just the things a camp cottage builder will be up against. The author is an architect and builder who likes simple camps. His book is friendly (235 pages, 6 by 8¾ inches, 69 illustrations)—$2.10 postpaid.—*A. G. I.*

PHOTOGRAPHIC CHEMICALS AND SOLUTIONS

By J. I. Crabtree and G. E. Matthews

REPRESENTING, as the authors state in their preface, "some of the knowledge acquired during the past twenty-five years in compounding photographic solutions and studying their application to photography in the Research Laboratories of the Eastman Kodak Company," this book needs no further recommendation. The atmosphere of authority fills every page of this thoroughly practical reference work, one that was written for both the amateur and the professional. An "index of formulas by purpose" is one of the most useful features of the book. The authors have made every effort to write in non-technical language wherever possible so that the book may be read and understood by all photographic workers. (360 pages, 6½ by 9½.)—$4.10 postpaid.—*J. D.*

The Editors Recommend

Best Sellers in Science

(Revised List)

1. SOILLESS GROWTH OF PLANTS—*By Carleton Ellis and Milton W. Swaney.* Complete information, popularly presented, regarding the problems and difficulties of tank farming. Formulas for chemicals and instructions for preparing tanks and other containers are given. Recommended to both experimenters and commercial growers. **$2.85**

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16. THE MYSTERIOUS UNIVERSE—*By Sir James Jeans.* Covers a remarkably broad territory, touching on everything new in modern physics, astrophysics, and cosmology. Many men of science now are leaning toward a non-materialistic interpretation of the universe and Jeans is one of these.—(Formerly $2.40) Now **$1.10**

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25. THE GLASS GIANT OF PALOMAR—*By David O. Woodbury.* Most readable story of human side of behind-the-scenes work on the great 200-inch telescope. Swiftly moving narrative begins with conception of telescope and proceeds steadily down through work in 1939. Authentic, largely about people, plus engineering. **$3.10**

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TELESCOPTICS

A Monthly Department for the Amateur Telescope Maker

Conducted by ALBERT G. INGALLS

TELESCOPE makers who plan lightweight and spindly-legged tripods are urged to study the proportions of the tripod in Figure 1. With the heavy mounting and 4" refractor the total weight is 288 pounds John McLennan, 1424 Oakwood Ave., Akron, Ohio, is the maker and he says the four main castings are of bronze with proportion 85 percent copper, 15 percent tin The rugged axes are 2" and 2⅛" in diameter, respectively, and both turn in precision ball bearings filled with grease

Figure 1. McLennan and telescope

There are setting circles on both axes and the polar axis has a slip ring for setting on sidereal time when starting to observe

"When making the working drawings for the mounting I did not think it would work out so heavy," McLennan writes, "but I am very well pleased with it I am not a machinist—just a home-trained mechanic"

Not only is this mounting rugged but it also is clean, regarded as a piece of design Excellent proportion

REFRACTOR making is beginning to catch on A decade ago it was being discouraged for amateurs When "ATM" was first put together, largely from Ellison's book "The Amateur's Telescope," the full American reprint rights of which were purchased, Ellison's chapters on the refractor were omitted The reflector, not the refractor, is the amateur's meat, we said then By 1928 (second edition of "ATM") we had softened enough to insert a guarded note on "The Objective Lens" (page 258, 2nd ed), pointing out the difficulty of the work, and that same note, only lukewarm on refractors, was reprinted in the third and fourth editions (page 333). Last year, when we reprinted the fourth edition, we slipped out that old discouraging note and substituted one that now encourages the amateur to make a refractor. Thus, 13 years produced a complete about face. Just a diplomatic way of saying that in 13 years the amateur has steadily risen, risen, risen in his ability.

Speaking of refractors, the next item may throw some added light on them—literally.

IN Figure 2 are two pairs of superposed, flat-faced disks of flint glass You can see far more clearly through the pair on the right. This is because the latter have been coated with the new metallic fluorides, and the day may come when amateur objective lens makers will send their components away to be treated, or do it themselves if equipped This should add about 20 percent to the light transmission through a two-element objective Refractors give steadier images than reflectors but lower illumination, hence this will be a big help. Here is the background, assembled from different sources, published and unpublished.

In 1892, H Dennis Taylor, a noted British lens designer, began to take notice of the effect of tarnished films on lenses when some flint elements were returned for repolishing His tests showed that, if a photographic plate was exposed under identical conditions, through a tarnished and an untarnished lens, more light would reach the plate through the former Said he "Whereas a thin plate of dense flint glass of the type usually used for objectives will, when freshly polished, reflect back from its two surfaces about 11 percent of the light falling upon it, and transmit 89 percent, the same plate when tarnished . . will reflect back only about 5 percent, and transmit 95 percent " He therefore attempted to tarnish lenses artificially by immersing them in various solutions, and found that hydrogen sulfide and alkaline sulfides reduced reflection appreciably.

In 1916, Kollmorgen, "acting upon the hints contained in Taylor's description, experimented a good deal with different chemicals along the same lines and found means of oxidizing most of the glasses used in optical work," according to a paper delivered before the Illuminating Engineering Society

At about the same time, Dr. Hermann Kellner, who was head of the Scientific Bureau of Bausch and Lomb, was working along similar lines He mentioned his experiments to Dr. F. E. Wright, during the latter's labors at the Bausch and Lomb plant in 1917, as a member of the group of silicate chemists aiding the Government in securing its requirements Dr Wright began a series of experiments with Dr. J B Ferguson Although these were never concluded, reflectivity was definitely decreased and Dr Wright offered three hypotheses to account for the phenomenon, the most likely one being that, in the process of etching by the attacking solution, the surface becomes covered with minute pits which are small compared with the wavelength of light.

In 1936, John Strong described a physical method of coating films to produce the same effect as the chemical method. His process involved the evaporation of metallic fluorides in a high vacuum. He described the use of a film of decreasing index of refraction which starts out with the full index next to the glass. This was done by depositing a film of fluorite, solid below and porous above. Agreeing with the Wright hypothesis, he states that "the grain of this porosity is small compared with a wavelength of light, as evidenced by the fact that it does not scatter light" With such a film he noted decreases in reflection of from 54 percent to 85 percent, depending on the angle of incident light.

Since Strong's work several physicists have used this technique, among them being Cartwright and Turner who have used various metallic fluorides to produce imperceptible films on glass to increase the transmission of light

Simultaneously, Dr. Katherine Blodgett, working on a project originally instituted by Dr. Irving Langmuir, employed films of barium stearate and other fatty acids to form a thin molecular surface on glass The glass was dipped into a tank of liquid on the surface of which an insoluble soap one molecule thick was placed As the glass was dipped down, one layer of film was attached, and on withdrawal another layer was applied, each full immersion adding two layers, each one molecule thick It took 44 successive layers to build up a film to a thickness of a quarter wavelength of light Dr Blodgett came to the conclusion that, except for the loss of light by absorption in the glass itself, film treated lenses could be made to transmit 100 percent of the incident light.

The metallic fluorides, however, are much tougher films than the fatty acid types In the long series of investigations conducted by Dr W. B. Rayton in the Bausch and Lomb laboratories during this period, it was evident that a combination of two processes could be used to greatest advantage. On lenses having an exposed outer surface a corrosive chemical process is used in which oxides of high refractive index are removed from the surface, leaving an in-

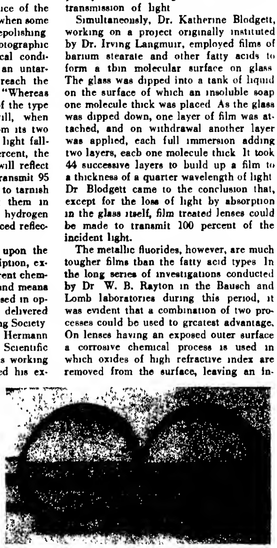


Figure 2: **Contrast—the old and the new**

visible structure of silica, while the inner glass-air surfaces are coated by the deposition of a metallic fluoride in a high vacuum.

In both processes the coating is held to a thickness of a quarter wavelength of light, or about four millionths of an inch The film must be intermediate in refractive index between air and glass. Since both the film and the lens surface reflect light, it is necessary that the crests of the waves from one beam shall fall into the troughs of the other Thus, being out of phase, the waves neutralize each other and reflection is decreased or entirely eliminated. The missing radiation reappears in the transmitted beam which has been shown to contain as much as 99.6 percent of the original radiation.

From 4 to 6 percent of the incident light is lost at each glass-air surface of a lens, the precise amount depending upon the type of glass used and the color of the light A crown glass-air surface reflects about 4 percent of the light, whereas flint reflects 6 percent It will readily be seen that, in a lens with a number of elements, or in optical instruments with complex systems of optical parts, light transmission can be increased tremendously Equally important is the reduction of halo and the improvement in image contrast

The new coating processes are at present being confined to a limited number of products but the progress so far attained offers a wide field for experiment which may prove a great step forward in optics One advanced amateur who has seen some experimentally coated binoculars says the difference is striking, as binoculars have from 10 to 15 surfaces, giving fine opportunity for the beneficial effects to pile up.

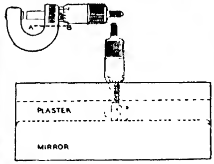
HIGH cost of gas for melting quartz was one big reason for giving up the original intention of making the 200" mirror disk of that material, as the melting point of quartz is very high Behind the following communication from John Ferguson, consulting engineer, 4 E. 194th St, Cleveland, Ohio, may be something new and significant

"I send you," he writes, "a photograph (Figure 3) of a paraboloidal mirror which is unique It is made of borosilicate glass, is 15" in diameter, 3" deep, and of cellular construction I believe it to be the first mirror ever to be made from glass which

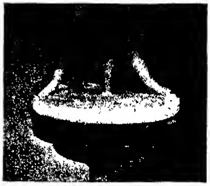
Figure 3: Ferguson and unique disk

THE BEGINNER'S CORNER

ALMOST the first concern of the beginner is to tell how deep the curve of his mirror has been ground. The classic way to do this is by means of a curved template but there are shorter, better methods The illustrations show the simple yet efficient one devised by Paul G Blaisdell, M D, 102 N Madison, Pasadena, Calif, and are almost self-explanatory. The anvil



part of a five and-ten cent store micrometer calipers reading to a thousandth of an inch was sawed off along line $A—B$, in the Doctor's drawing, and discarded, leaving a stub for anchorage. A paper collar was fastened around the mirror disk, just



as in preparing to make a pitch lap, as described in the book "Amateur Telescope Making," except much higher The spindle of the micrometer was run back till its end was flush with the remaining part of the frame, the micrometer was centered and held accurately on the glass, and plaster of Paris was poured around it. Before any grinding was done the actual reading of the spherometer was noted and used thereafter as its zero point The photograph shows how it is used the other hand holds the plaster disk in accurate register with the glass

Dr Blaisdell states that this spherometer gave readings that checked with solar focus readings and cost only 35 cents to make He obtained his micrometer from The Pep Boys, 169 W Colorado St, Pasadena, for a little less than a quarter

TELESCOPTICS

(*Continued from preceding page*)

was melted electrically, as distinguished from fuel fired furnace melting. The process of melting the glass was developed by the writer, the heat for melting being generated by the flow of electric current through the glass material itself, acting as a resistor

"Glass at normal temperature is a good insulator, but it is capable of conducting current when heated. In this respect it is classed as an unstable resistor, its resistance becomes progressively lower as it is heated Being a liquid, it cannot burn out, as solid resistors will do at high temperatures, so the melting temperatures can be pressed up to as high values as the refractory containers will withstand, and one of the advantages of this is that very refractory glasses can be melted

"It may, of course, occur to the reader to wonder how the glass ingredients—sand, borax, soda, lime and so on—are brought to an initial temperature condition where they will begin to conduct the current in appreciable quantity. They become conductive at 500° to 600° C. and there are several methods of producing this temperature, after which the flow of molten glass and the entire process becomes continuous.

"The electrical process of melting glass appears to promise glasses of superior characteristics for mirrors Glasses have been successfully melted with a silica content as high as 87 percent, with quite low expansion factors The nature of the operation also will lend itself to the production of quite large mirrors at considerably less cost than has heretofore been possible"

It is said that the process is already in use by two large American glass companies making glass for purposes other than mirror disks A detailed account is to appear in the *Journal of the American Ceramic Society* What effect this process may have on the availability of mirror disks having a higher silica content, and therefore less expansion effect, than those now available, this department knows not at the present writing Pyrex disks of the sizes most commonly sold to amateur telescope makers (under 12½") contain 80 percent silica, the larger ones 87 percent

TO all quarters of the earth goes Scientific American and many of its readers obtain "ATM" afterward One is the Rev Emil W Menzel, of the American Evangelical Mission, Bisrampur, C P, *Via* Bhatapara (B N Ry), India, whose telescope is shown in Figure 4 It has a 10" mirror made of a port-hole glass and the mounting is of the open, "spinal column" type, the neat column being a piece of steel channel It is equipped with setting circles "Since I live in the jungle it has been hard to get machined parts," its maker states, "and so the mounting is about as primitive as it can be and still do service. The long focus gives plenty of exercise climbing on boxes and tables The telescope is mighty good company on lonely, hot nights when you sleep outdoors under the stars with it at your bed-side." Note the low angle of the polar axis, designed for the latitude of India's Central Provinces, in about 20° North.

ALL mirror makers have been asked whether the rouge they use is "the same kind" One answer might be obtainable simply by inviting the ladies in your circle to apply some of your rouge to their faces; no doubt they just wouldn't. Or by trying some of theirs on your mirror. Even

so, how many users of red optical rouge, which is ferric oxide (Fe_2O_3), can say with assurance what, if anything, the two genders of rouge have in common, besides the color red, rouge being simply the French word for red (which, incidentally, makes one ask why some people call Levigated Alumina "white rouge").

These weighty questions having kept your scribe awake nights for the past dozen years, he asked Horace H Selby, author of the chapter on making optical rouge, as well as other chapters, in "ATMA," and who is a professional chemist, for the answers. Here is what Selby replied "You got me curious with your inquiry so I got some samples—three kinds—and went to work Was I surprised! Not a mil-

Figure 4 Menzel and reflector

ligram of red Fe_2O_3 in the lot! In two of the seven shades, I found approximately 3 per cent of a yellow iron oxide presumably ocher In general, all were dried cakes of gums (acacia, tragacanth or India) holding together mixtures of magnesium silicate ("French chalk," "talc" and so on), aluminum silicate (colloidal kaolin or clay), calcium carbonate (chalk), zinc oxide and colors Of the colors, I identified the following ammonium carminate, carminic acid, a fluorescein salt, yellow ocher, a nitro fluorescein—possibly eosin scarlet Some other colors were present which I couldn't spot easily They were lakes, and some were blue, some yellowish The preponderant colors were of the cochineal group, however (carminic acid and salts and crude carmin)"

Accompanying this learned report, Selby sent a table showing that seven rouge compacts were tested by him for 20 components each To keep the peace we suppress the makes, you wouldn't know them if you saw them, anyway (or would you?). Selby says he did about $100 worth of work on the job. Knowing, however, that he would not be interested in mere money, we have decided to award him, instead, and on behalf of all amateur telescopedom, an honorary degree. Now the degree of J. U D *(Juris utriusque Doctor)* stands for "Doctor of Both Laws," that is, canon and civil, so why not create for Selby the degree of R. U. D. *(Rubrorum utriusque Doctor)*, which means "Doctor of Both Rouges". So be it, and Selby is ennobled for his rouge research.

CURRENT BULLETIN BRIEFS

(The Editor will appreciate it if you will mention Scientific American when writing for any of the publications listed below.)

ELIZABETHAN MYSTERY MAN, by Charles Wisner Barrell, is a 24-page digest of evidence connecting Edward de Vere, 17th Earl of Oxford, with the literary activities of "Mr William Shakespeare" The author, Mr. Barrell, prepared the widely quoted article, "Identifying Shakespeare," which was published in the January, 1940, issue of Scientific American *August Gauthier, 17 East 48th Street, New York, New York — 25 cents*

INFRA RED PHOTOGRAPHY WITH KODAK MATERIALS, is a 34-page copiously illustrated paper-bound booklet Covering the subject from both the theoretical and practical aspects, the booklet is complete with specification tables for the various emulsions available The text treats of the nature of infra-red radiation and photographic applications in many fields Also included are data on lenses and filters suitable for infra red work, hypersensitizing techniques, exposure for landscape pictures, and shots by artificial light *Eastman Kodak Company, Rochester, New York. — 25 cents.*

ARITHMETIC MADE EASY, by Alva Cole, C E, is a 42-page, compact, meaty compendium of short rules and instructions for solving numerous, everyday commercial problems by new methods that largely eliminate the use of a pencil *Neighbor and Riggs, Inc, 11 South Fourth St, Newark, Ohio — 95 cents*

RADIO AND EDUCATION, by David Sarnoff, is a 27 page reprint of a recent address in which Mr Sarnoff outlined the educational services offered by radio in all its phases, and touched briefly on the possibilities of education by television. An appendix lists sustaining public-service programs on NBC networks. *Radio Corporation of America, 30 Rockefeller Plaza, New York, New York. — Gratis.*

AUTOMOTIVE, PORTABLE AND SPECIALTY EQUIPMENT is a 44-page illustrated catalog that presents, in condensed form, details of complete spray-painting equipment for exterior and interior use as well as automobile refinishing It also lists equipment for automobile service work as well as air and fluid hose and other specialties. *The DeVilbiss Company, Toledo, Ohio. — Gratis.*

SELECTED EDITORIALS FROM LINK-BELT NEWS is a 64-page digest of editorial material which has appeared in past issues of a monthly trade paper. The editorials are of wide interest to business in general, and are mainly of a philosophical and inspiration nature. *Link-Belt Company, 307 N Michigan Avenue, Chicago, Illinois. — Gratis*

COLOR PRINTING SIMPLIFIED, by Thomas S. Curtis, Sc.D., is a 63-page booklet which aims "to reduce to the simplest common denominator the basic factors which govern the making of the color print and to point out those common errors, the elimination of which converts color printing into a pleasurable hobby." *Thomas S. Curtis Laboratories, 2063-2065 East Gage Avenue, Huntington Park, Calif. — 25 cents.*

? is a pocket-size booklet which answers a wide variety of questions regarding the operation of railroads. In eminently readable form it gives data regarding rails, freight and passenger movements, freight rates, tunnels, railway taxes, railway refrigeration, and so on. *Association of American Railroads, Washington, D. C. — Gratis.*

AMERICA TAKES A TEST is a 12 page illustrated pamphlet which gives specific data regarding airline air travel in the United States It presents facts regarding safety factors, flight conditions, schedules fulfilled, effects of storms, and so on. *American Airlines, Inc., New York Municipal Airport, New York, New York — Gratis.*

EMERSON-ELECTRIC FANS is a 24-page thoroughly illustrated catalog issued in commemoration of the 50th Anniversary of the company. It lists nearly a hundred types of fans including desk and stand fans, air circulators, ceiling fans, ventilating fans, and so on Request your copy on business stationery. *The Emerson Electric Mfg Company, St. Louis, Missouri. — Gratis.*

SCRAP IRON AND STEEL is a 40-page booklet which presents an outline of the many ramifications and developments of the scrap-iron industry. It contains statistics, formulas, and other data pertaining to scrap iron and, also, gives a description of the manufacture of steel *Jack Gutstadt, 12 East Grand Avenue, Chicago, Illinois. — $1.00.*

$200,000 INDUSTRIAL PROGRESS AWARD PROGRAM is a 48-page brochure which presents the results of more than a year of planning and development aimed toward the formulation of a program of industrial study and research which would be productive of the greatest possible benefit not only to industry but to society at large Request your copy on business stationery. *The James F Lincoln Arc Welding Foundation, Cleveland, Ohio. — Gratis.*

ART IN EYEGLASSES, by Frank Graham Murphy, M D, is a treatise on the art of selecting eyeglasses that conform to the rythmic lines of the face, in other words, if you must wear glasses, carefully select those which don't wholly spoil your good looks *Frank G Murphy, M D, 305 First National Bank Bldg, Mason City, Iowa. — $1.00.*

PITTSBURGH PLATE PRODUCTS is a by-monthly publication devoted to the industrial and home uses of glass and paint. It is thoroughly illustrated *Pittsburgh Plate Glass Company, Pittsburgh, Pennsylvania.*

THE MECHANICAL INVENTIONS OF EMANUEL SWEDENBORG, edited by Alfred Acton, describes in their true light and without the common exaggeration all the mechanical inventions of the philosopher Swedenborg. *Swedenborg Scientific Association, Bryn Athen, Pennsylvania. — 60 cents.*

LEGAL HIGH-LIGHTS

Patent, Trade Mark, and Related Legal Proceedings That May Have a Direct Effect on Your Business

By ORSON D. MUNN, Litt.B., L.L.B., Sc.D.
New York Bar
Editor, Scientific American

Crown Caps

A CROWN cap is not a valve This is probably not news of a startling character to most of our readers However, it has been judicially determined for the first time in a suit involving a patent on a tin can.

The patent related to a tin can having a discharge nozzle and manually operated valve controlling the nozzle The patentee brought suit for patent infringement against the manufacturer of a beer can having a pouring opening closed by a crown cap. It was contended by the patentee that the crown cap constituted a valve The court however, after considering the dictionary definition of a valve, rejected this contention and held that a crown cap was not a valve and that the beer can did not infringe the patent in suit.

Bubble Tower

A PROCESS patent cannot be based merely upon the apparatus employed in carrying out a process This principle is illustrated by a recent case for infringement of two patents relating to the distillation of fatty acids Fatty acids are derived from animal and vegetable fats and oils The first step in removing the fatty acids from the fats and oils is to separate or split the oils and fats into glycerine and fatty acids and then to extract the glycerine by physical means The remaining product is a mixture of fatty acids and impurities. The impurities are removed from the acids by means of a distillation process

In the distillation process care must be exercised because the fatty acids decompose before reaching distillation temperature at normal atmospheric pressure Therefore, it has been customary to distill the fatty acids under a partial vacuum or with a volitalization agent such as steam Prior to the inventions covered by the patents in suit, it was customary to distill the fatty acids in pot stills. The patent in suit disclosed the use of distillation columns or towers rather than pot stills. The first patent disclosed a distilling column or tower known as a baffle tower and the second patent disclosed a bubble tower. Apparently the patentees were the first ones to use baffle towers and bubble towers in connection with the distillation of fatty acids, although they had been used for many years in connection with the distillation of other products, such as petroleum.

The court found that the only difference between the prior distilling process and the patented processes resided in the inherent nature and operation of the baffle tower and the bubble tower. The court also found that the substitution of bubble towers and baffle towers, which were well known in analogous arts, did not constitute invention. As a result, the court concluded that the two patents were invalid In this connection, the court observed:

"The difference between pot still distillation and continuous-still distillation is in reality a difference inherent in different types of apparatus. A process in the patent sense is a series of steps involving physical or chemical changes in the material operated upon It converts that material into something of different physical and chemical characteristics Invention must be found in the sequence of steps performed on the material treated, not in the apparatus necessary to carry out the process."

Thatched Roof

EVEN our quaint and ancient modes of life are not free from the encroachments of modern industrial development Thus a recent suit in a federal court involved a patent covering a thatched roof The patent disclosed an asbestos paper envelope impregnated with asphalt, having suitable brush material such as straw or fiber strands inserted in the envelope and protruding from it.

In applying the roofing material to the roof, the envelopes of successive courses were arranged in overlapping relationship and the protruding portion of the brush was of sufficient length to cover and conceal the envelope of the adjacent course The impregnated envelopes thus formed an effective water-proof covering for the roof and the brush merely served a decorative or ornamental purpose. In the old-fashioned thatched roof, it was necessary to provide a mass of thatch fibers of sufficient thickness to cause the water to drain along the fibers and off of the roof before penetrating to the roof boards beneath the fibers.

The court acknowledged the improved character of the patented thatched roof but nevertheless declared that the patent was invalid because of its close similarity to two earlier patents, one of which related to a roofing material consisting of a plurality of wires having their ends imbedded in water-proof envelopes.

O-Ke-Doke

IN an opposition proceeding involving the trade mark O-Ke-Doke, soft drinks were held to be goods of different descriptive properties from cheese and cheese-coated popcorn.

A beverage manufacturer attempted to register the trade mark O-Ke-Dokee for soft drinks and the registration was opposed by a cheese manufacturer on the grounds that it was deceptively similar to his trade mark, O-Ke-Doke, for cheese and cheese-coated popcorn It was contended by the beverage manufacturer that soft drinks were so different in character from cheese and popcorn that there was no danger of confusion.

In an attempt to rebut this contention, the cheese manufacturer argued that cheese-covered popcorn is sold and distributed in taverns along with soft drinks. In this connection, it was pointed out that the popcorn was advertised as a thirst creator and accordingly was used in taverns for the purpose of increasing the sale of beverages. The cheese manufacturer also contended that soft drinks and popcorn were frequently sold in the same stores, namely, drug stores and chain stores

The court, however, concluded that the merchandise of the respective parties were of different descriptive properties and that there was no danger of confusion in the trade

In reaching the above conclusion the court made the following interesting comments with regard to taverns and drug and chain stores

"It does not appear from the record that taverns, which are alleged to be the principal outlet for opposer's goods, cater especially to the soft drink trade, and, with respect to the drug and chain stores where the goods of both parties appear to be sold, it is a matter of common knowledge that such institutions sell an almost unlimited variety of articles in distinct and substantially unrelated lines of trade"

Mammy

A RESTAURANT proprietor was accorded the exclusive right to use the name Mammy in connection with the operation of a restaurant in a particular locality by a recent decision of the New York State Supreme Court

The decision discloses that the plaintiff in the case used the name Mammy's Chicken Farm on his restaurant and he prominently displayed the word Mammy in connection with a picture or caricature of a southern negress of the type generally known as a Mammy The defendant opened a restaurant in the same neighborhood and also prominently displayed the word Mammy and a similar picture Both establishments featured southern cooking of the type generally referred to as Mammy cooking.

The court concluded that the use by the defendant of a name and picture similar to the plaintiff's constituted unfair competition, and awarded an injunction restraining the defendant from displaying or using the name or picture.

Parcheesi

THE game known as "Parcheesi" has been popular in the United States for many years. Many will be surprised to learn that the name "Parcheesi" is a registered trade mark owned by one manufacturer. Recently, a competing manufacturer manufactured and sold a similar game under the name "Parchesi" and the original manufacturer filed suit for trade-mark infringement and unfair competition. Pending the trial of the suit the court granted a preliminary injunction restraining the use by the second manufacturer of the name "Parchesi" or any similar name.

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SCIENTIFIC AMERICAN

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NINETY-SIXTH YEAR — ORSON D. MUNN, Editor

CONTENTS

INDUSTRIAL progress frequently revolves around a strict attention to small details. An example is the valve-stem testing machine illustrated on our front cover. This machine, used in testing the valves in Pontiac motors, presses a precision ground, cone-shaped diamond into the end of the stem. If the diamond digs deeper than the permitted tolerance, the stem is rejected. Hand-operated machines work at a rate of 200 stems an hour; this new electrical tester checks 600 stems an hour.

SCIENTIFIC AMERICAN, May, 1940. Vol No 162, No 5, entered at the New York, N Y Post Office as second class matter June 28, 1879, under the act of March 3rd, 1879, additional entry at Orange, Conn Published monthly by Munn & Company, Inc, 24 West 40th Street, New York City. Copyrighted 1940 by Munn & Company, Inc. Great Britain rights reserved. Subscription price $4 00 per year Canada $4 50 Foreign $5 00 Manuscripts are submitted at the author's risk and cannot be returned unless accompanied by postage

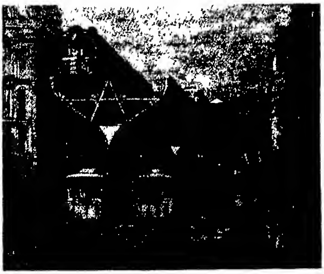
50 Years Ago in . . .

Scientific American

(Condensed From Issues of May, 1890)

NEW DEAL?—"When the government buys what every one produces, and pensions every individual in the nation with the taxes collected from every one the government will, of course, then dictate what shall be produced and who shall produce it"

ELEVATED—"In all city streets where there are two surface railway tracks there is a space between them of little use except for direct crossing To utilize this space is the object of the elevated railway illustrated It carries two tracks, supported upon a single line of columns Taken in combination with street tracks



below, it practically solves the question of rapid transit. The upper cars move at high speed, make few stops, and carry people quickly to long distances The lower cars move more slowly, stop often, and take local travel chiefly Long distance passengers can ride on the surface cars to the nearest elevated station and then take an express train"

BALLOONETS—"Mr Andre Mahoudeau describes, in *Les Inventions Nouvelles*, a new kind of balloon devised by him, and divided into several compartments One of the advantages of this system is that a rent in the balloon does not imperil the life of the aeronaut Each compartment is provided with a pipe that descends through a central funnel In this way, it is possible to inflate the compartments independently of one another, and with gases of different natures"

INVENTORS—"If there is any man to whom the term 'self-made' will most truly apply, it is the inventor He must possess three general characteristics peculiar to all men who achieve success in life, but in more full development than most others, to wit, ingenuity, enthusiasm, and perseverance Like the true poet, his soul is in his work, but his is the poetry of substantial achievement, which gives wealth, as well as happiness, to mankind"

STEEL PIPES—"Steel pipes as a substitute for cast iron now form an important item for the engineer's consideration in the conveyance of water Such pipes are being adopted for several reasons As their weight is only about one-quarter the weight of cast iron pipes for the same service, the matter of transportation forms an important consideration They are also much less liable to fracture than cast iron"

HEAVY GUN—"The first high-power, breech loading 8-inch rifle made entirely of American steel lately passed a successful test at the Naval Ordnance Proving Ground at Annapolis The gun is one of four intended for the cruiser *Baltimore* Its forgings are from Bethlehem, and the machining and assembling were done at the Washington Navy Yard With a sample of brown prismatic powder furnished by Messrs Du Pont, of Wilmington, Del, a muzzle velocity of 2,129 feet per second was obtained with a 110 pound charge and 155 tons pressure The projectile weighed 250 pounds and its velocity was the highest ever attained by an 8-inch shell in this country"

LABOR SAVING—"One of the latest inventions is a machine for buttering bread It is used in connection with a patent bread cutter, and is intended for use in prisons, workhouses, and other reformatory institutions There is a cylindrical shaped brush which is fed with butter, and lays a thin layer on the bread as it comes from the cutter The machine can be worked by hand, steam, or electricity, and has a capacity of cutting and buttering 750 loaves of bread an hour The saving of butter and of bread and the decrease in the quantity of crumbs is said to be very large"

AND IRON MEN—"The largest wooden vessel afloat is the *Rappahannock* She was built at Bath, Maine, and cost $125,000 The vessel is 287 feet long, 48¾ feet beam, and her total tonnage is 3,053 net. In the construction of the ship 700 tons of Virginian oak and 1,200,000 feet of Virginian pine timber were used The ship has a steel bowsprit, which is an innovation Her spread of canvas will be 15,000 yards"

SURGERY—"At the Surgical Congress at Berlin, Professor Gluck, of Berlin, gave an exhibition showing a most valuable advance in surgery, namely, the successful substitution of catgut, ivory, and bone freed from chalk, for defects in bones, muscles, and nerve sinews. He presented the cases of patients in whom there had been an insertion of from six to ten centimeters of catgut to supply defects in the leaders of the bands, to which complete mobility had been restored In the case of another patient Professor Gluck removed a tumor from the thigh, causing a considerable defect in the bone. He inserted ivory, and no shortening ensued"

POWER "A scheme has been organized and work begun to generate electricity, by the aid of Niagara, sufficient to drive all the machinery in the mills and factories, propel every horse car, light up every street, avenue, and road in and around the village of Niagara Falls, the city of Buffalo, and the neighboring towns and villages The present plans contemplate the production of 120,000 horsepower, but there is no limit to the amount of power which may be produced"

AND NOW FOR THE FUTURE

¶ What sort of inventions will help to win modern wars? By Major William H. Wenstrom.

¶ Long-range weather forecasting based on findings in a bog By W. F McCulloch.

¶ Commercial possibilities of tantalum, a new-old metal. By Philip H. Smith.

¶ Marvels of the aurora borealis, with illustrations by William Crowder.

¶ Artificial lightning, a big gun of science. By C. W. Sheppard.

Personalities in Science

ERNEST O. LAWRENCE

CHINA in the early 1920's presented a picture of chaos. Warring factions ravaged the country Nevertheless, by extremely roundabout method, the conflict in China contributed heavily to a chain of events that has led to astounding new knowledge of the world in which we live, a promise of future benefits to mankind, and, incidentally to the award of the 1939 Nobel Prize for physics to Dr Ernest O Lawrence, developer of the atom-smashing cyclotron and professor of physics at the University of California

Following the close of the World War the Federal Wireless Company had planned to establish a large station in China An 85-ton magnet had been constructed for use in this establishment The turmoil in China forced reconsideration of these plans, consequently the company was left with a huge magnet which it was anxious to dispose of

The magnet was purchased by the University of California, to be used as the heart of a new machine called the cyclotron This machine was to be used by Dr Lawrence, then newly-arrived from Yale, to explore the interior of the atom. A much smaller cyclotron had already been constructed and had proved its worth in the laboratory, but this was mere child's play in comparison with the work which Dr Lawrence desired to perform He wanted to break up the closely knit structure of the atom to see what it was really composed of, and to find out what results might be obtained when the tiny citadel in the nucleus of the atom had been destroyed To do this he needed a cyclotron many times larger and more powerful than his laboratory model The first requisite was to purchase a large magnet cheap The one owned by the Federal Wireless Company answered these qualifications

The new cyclotron, with its 85-ton magnet, was installed in the Radiation Laboratory at the University Once it was put into operation exciting news began appearing in scientific journals. Lawrence had smashed the atom more easily than it had ever been done before. He had created strange new substances, never before seen on earth. They were simply sodium, phosphorous, or iron, when they were first put under the blast of the cyclotron, but after being subjected to bombardment they became radioactive For the first time the world came into possession of radioactive materials that could be manufactured at will were many times less expensive than radium, and had advantages over radium through the ease with which they can be handled A new type of radiation, the neutron ray, was discovered And, while all of these discoveries were of fundamental importance to the science of physics, they also have proved to have tremendous significance in the field of medicine

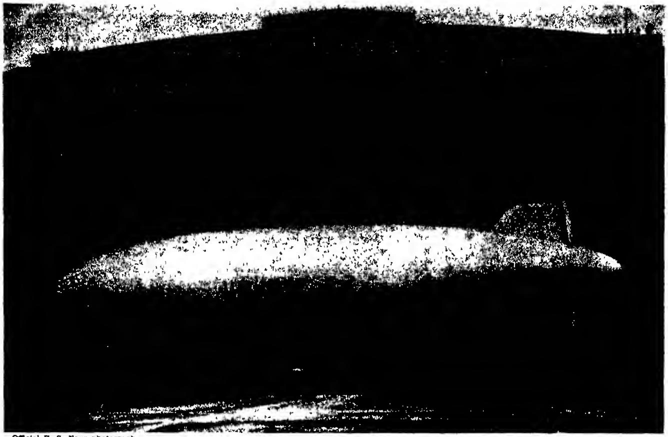
During the past year the new W H Crocker Radiation Laboratory has been constructed on the University of California campus It contains, beside a new giant cyclotron with a 225-ton magnet, facilities for laboratory experimentation with the new radioactive materials and for treatment of cancer with the neutron ray Now Dr Lawrence is planning the construction of another and even larger cyclotron — one weighing 3000 tons — with which he hopes to unleash the energy locked within the atomic structure, if he can get the money

The University of California physicist is one of the youngest men ever to be awarded a Nobel Prize With his youth he combines imagination, resourcefulness, enthusiasm and, above all a keen, analytical mind He has surrounded himself with a particularly able staff and insists that they share every honor with him Under the impetus of Dr Lawrence's executive ability and far-sightedness, the Radiation Laboratory has become a research institute of the highest rank

Dr Lawrence was born in Canton, South Dakota, in 1901 He is a graduate of St Olaf College, Northfield, Minnesota, and the University of South Dakota. He holds M.A degrees from the University of Minnesota and the University of Chicago, and a Ph.D from Yale University. Before coming to the University of California, he was a member of the faculty at Yale For recreation he likes ice skating, boating, and tennis

FLAGSHIP OF A RECORD-BREAKING FLEET

OVER the bumpy air of New York City, five blimps, of which the *Rainbow* shown above is the flagship, have flown almost continually for many months Filled with helium, paying little attention to the vagaries of weather, these ships have proved the air-worthiness of this type which is discussed in the article on the opposite page. Up to April 1, 1940, these five Goodyear airships had flown 3,646,000 miles in a total of 134,771 flights and 81,631 hours of flying time, carrying a total of 362,231 passengers without accident Such a record makes understandable the Navy's desire for such ships



Official U S Navy photograph
Only a small ground crew is necessary to dock this sleek little craft at Lakehurst. It is filled with non-explosive helium

Blimps And Modern Warfare

Neglected Type Used Successfully in World War . . . Potentialities for Scouting, Patrol, Convoy Work . . . New Bill Calls for Several Dozen

By BROCKHOLST LIVINGSTON

IN an effort to round out our naval defenses, Congressman Vinson Chairman of the House Naval Affairs Committee, early this year introduced a bill to provide for further expansion Included in the proposed authorizations is one which permits the President to acquire lighter-than air craft so that a total of not more than 36 useful ships of this type may be maintained This is the largest such program ever proposed for the United States in time of peace

None can deny the advances made with the airplane, but this form of flying has not out-moded the airship for war-time uses Both have limitations but the one can supplement the other What many have forgotten is that there are two major branches to the science of aviation

Lighter than-air comprises various types, just as we have the larger patrol planes and the tiny fighters in heavier than-air. The Navy, charged with the development of the rigid airship in this country, is still hopeful that further development of this type will be permitted but, meanwhile, believes in the efficacy of the non-rigid, or blimp, for training, patrol, observation, and other duties.

When the first World War broke out, the nations knew little of the capabilities of blimps It was not long, however, before most were utilizing these ships for all manner of purposes Even when filled with hydrogen, that demon of the airship, belligerents' blimps made many thousands of successful flights As the only available lifting gas, hydrogen had to be used even though it increased the vulnerability of the ships At present, we alone of the nations of the world possess a supply of helium a non flammable lifting gas but we have given little attention recently to airships as an arm of national defense

WHEN we entered the war in 1917 we hurried as best we could to make up our deficiencies but our earlier neglect necessitated the importation of instructors from the Allied air services

Eventually we constructed a large number of blimps which saw service along our own coasts and from bases constructed in Europe In a future emergency, we might not be fortunate enough to have allies to hold off the enemy for us while we build up our defenses That is probably why airships have been included in the expansion bill

In the last 18 months of the first World War, the British maintained an average of 56 blimps in service and in that period undertook 9059 patrols and 2210 escorts Blimps located 134 mines and destroyed 73 of them They sighted 49 submarines and attacked 27 with either gunfire or bombs Anti-submarine work by blimps was accomplished at far less cost than were similar tasks performed by surface vessels although, for best results, the two types should,

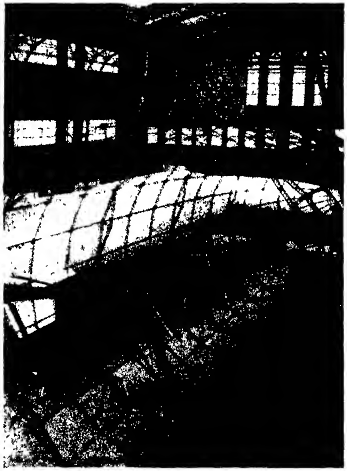
and did, co-operate fully with each other

Most authorities claim that no ship under convoy by blimps was sunk by submarine; some say only two. Even accepting the latter figure as correct, the efficacy of the blimp, considering the many thousands of ships escorted, is almost phenomenal. It is worthy of note that while the British began the present war without blimps, they have instituted balloon patrols for spotting mine-laying operations.

In 1915, blimps flew only 339 hours, but in 1918 their operations and the number in service had so increased that 53,554 hours were flown. For every blimp fatality, 42,548 miles were covered. In the final eleven months of the last war, there were only nine days in which airships were grounded because of bad weather. This latter fact is of particular interest in view of the criticism directed at airships because of their supposed vulnerability to weather.

IN this connection, some interesting statistics were prepared by the Navy Department shortly after the Armistice in 1918. These showed that a large non-rigid in France had an average percentage time spent in operations of 27 and flew 5270 miles in the last month of the war as against averages of 45.7 for destroyers which covered 4582 miles, and 47.4 for coastal patrol vessels which sailed 2540.9 miles. The airship's flying time was 200.5 hours producing an average speed of 26.3 miles per hour which compares favorably as a convoy speed. The airship's operation record includes only time actually under way, while that for the other ships covers time spent at anchor during darkness as well. The comparison is very favorable to airships. To refute claims of the airship's dependence on favorable weather, it may be added that in the above case it was "worse than average" for the month.

Despite the favorable results obtained from blimp operations in the last war, the end of hostilities saw the beginning of a long period of neglect for this type. Interest in the development of rigid airships and the phenomenal advances made with the airplane retarded progress with a type which had proved its worth in war. Only a small fraction of what has been spent on experimentation with airplanes has been devoted to airships. Even with the limited funds available, however, great strides have been made by the airship branch of our naval aviation. No longer is the airship a crude, ill-shapen thing. Its "streamlining" and other modern developments match those of the airplane. Handling and operational advances have been made to the limit of available means.



Official U S Navy photograph

Two small blimps, *TC-14* and *G-1*, seen through the partly dismantled, German-built *Los Angeles* in a Lakehurst hangar

As lessons have been learned, the possibilities for extending the functions of the airship have increased. Besides the war-time duties of convoy and anti-submarine patrol which the blimp performed so well, the small airship has extended its usefulness to such duties as acting as aerial listening post offshore, carriage of infra-red optical range locating apparatus, photographing of the fall of shot in target practice, chasing practice torpedoes, and a long list of other important tasks. Blimps have carried planes in hook-on experiments although this is more within the province of the large rigid ships. Sea rescue work has been facilitated by the development of new devices recently tried out with success by ships from the Naval Air Station at Lakehurst (particularly anchoring devices to hold a blimp stationary within rope-ladder distance from the water — see page 161, March, 1940 Scientific American). Many of these tasks cannot be undertaken by heavier-than-air craft due to their higher speed, their inability to hover, and their relatively lower useful load capacity.

In a test conducted last spring by the Navy's *K-2* it was demonstrated conclusively that blimps may be used on expeditionary work. The objects of the flight were to test the feasibility of mooring a large non-rigid to an expeditionary mooring mast and of transporting mast and equipment by plane, to study the operating characteristics of *K-2* and generally to extend the range of usefulness of this type for coastal patrol operations. Each of these was successfully fulfilled. It was determined that the portable mast is adequate for mooring in reasonably severe weather and, on the flight in question, winds averaging 22 knots with peak gusts of $36\frac{1}{2}$ knots were encountered. It was found the mast could be readily transported by plane and quickly erected at the chosen location. Only a moderate sized landing field and a ground crew of 50 men are needed for operations of this type.

IT was recommended, following the completion of the flight, that the potentialities of the non-rigid airship be further investigated by means of similar operations and that the *K-2* be used for the purpose of familiarizing naval personnel with the possibilities of the blimp in support of local coastal defense measures. Nothing further along these lines was done, however, because the *K-2* was damaged shortly afterward and no other suitable blimp was available. This is a sad commentary on our American reputation for progress.

Nothing useful can be proved by attempts to show the relative merits of the various types which make up a naval force. Many proponents of the airship claim that one of this type is equal to so many cruisers or destroyers. Every known type has a distinct place in the scheme of defense and no one should be developed at the expense of another. However, we do know that, under given conditions, an airship can patrol a greater area than can any surface craft. Blimps are less expensive to construct and to operate than long-range patrol

planes and cost but a fraction of surface vessels capable of comparable performance The blimp, however, is not a combatant type and may be used to greater advantage for strategic than for tactical scouting.

Our present situation with regard to blimps is not reassuring. We have only eight Navy blimps available and some of these are not in operating condition. Only one, the *K-2*, was built specifically for the intended functions of a naval blimp The others, including two taken over from the Army when lighter-than-air activities were abandoned by them, range in age from two to ten years and are either adaptations of commercial types or fail to embody recent developments The *K-2* and the two ex-Army ships are the only ones at all suitable for extended patrol duties Endurance is dependent on volume, that is, roughly 10 hours at cruising speed for each 100 000 cubic feet of volume. An airship must, therefore, have a volume which will permit it to maintain reasonably extended patrol A volume of 400,000 to 500,000 cubic feet is considered satisfactory.

Included in our available ships is the *ZMC-2*, a completely metal clad, as opposed to fabric-covered ship. This craft built ten years ago as an experiment, is considered to have proved the practicability of metal hulls but we have failed to follow up its possibilities by constructing a ship of larger dimensions

OUR ground facilities are equally limited The air station at Lakehurst is the only one entirely suitable for lighter-than-air activities The station at Sunnyvale, California, is now under Army jurisdiction but may be returned to the Navy when required At Cape May, Coco Solo, and San Diego, there are small sheds capable of housing from one to four blimps each None is now in an operative status and ships suitable for assignment to them are not available Privately owned blimp sheds in nine different locations could be taken over by the Navy but several are so situated that they would be of little value as patrol bases The U S S *Wright* which started her career as a balloon tender is now employed with seaplanes, while the *Patoka*, recently recommissioned as an aircraft tender, can handle rigids but has no mast suitable for blimps.

Our personnel situation is not more reassuring. In 16 years we trained only 75 officers as naval airship pilots and many of these are no longer available to the Navy There are few Naval Reservists qualified for such service, and enlisted personnel trained for lighter-than-air has been widely scattered due to the lack of ships upon which they could continue their interest in this type All in all, the picture is not a bright one and yet situations are developing abroad which blimps helped to meet in the last war and could in this were they available Whether we shall enter the war or not does not detract from the necessity of our being prepared in every respect and with every arm modern warfare can utilize in its pursuit The loss of the *Courageous* might have been avoided if blimp patrols had flown over her operational area to determine the presence or absence of enemy submarines The *Royal Oak* might still be an active vessel of the British Navy if blimps had been on constant patrol duty outside the entrance to Scapa Flow Because of its higher speed, the airplane cannot perform these functions as well as the airship Flying over the sea at 150 miles an hour, one is more likely to miss objects below than if he is flying at only 50 miles an hour

Official U S Navy photograph

During wartime, blimps can scout the vicinity of merchant ships or convoys In this view the airship *J-4* is making contact with a merchant vessel

No one claims that the blimp is the answer to all our air problems but we had fairly conclusive evidence of its efficiency in 1914-18 If small, inexpensive non rigids can save even one ship which might otherwise become the victim of attack, the effort and expense involved in providing them have been worth while For the neutrality patrol which now occupies the attention of our naval forces, there is no more ideal type than the blimp. Patrols of this nature do not require heavily armed vessels but the ability to cover the tremendous areas around our shore-line is vital.

There are disadvantages to the airship and these are fully recognized by their advocates But, the same is true of every known type of naval vessel. We do not pit a cruiser against a battleship if we can help it and, similarly, we should not match the airship against stronger craft The mission of the air ship is to carry out its duty with least risk, and evasion is one of its strongest defenses

Blimps *have* a place in our naval establishment The provision of the number of airships referred to in Mr Vinson's bill would permit the granting of educational orders in line with our industrial preparedness program This will make it possible to maintain at least the nucleus of an airship industry in this country The ships to be provided will also permit the first large-scale operations both with the fleet and on local defense duties It should be possible by these means to determine more accurately the full extent of the capabilities of blimps as adjuncts of the national defense and to continue the training of personnel which we shall need in an emergency Further development of experimental types such as the metal clad airship may also be undertaken Our extensive coast line makes the airship particularly valuable to us and our possession of the world's helium supply decreases the vulnerability of the type.

War rages abroad No man can foresee when or how we may be drawn into its flames We have neglected the blimp for far too long It is time we got started on making up for our neglect The program which has been proposed is evidence of a growing recognition of this.

WHO WAS SHAKESPEARE?

Reader Response to X-ray Revelations of Identity of Shakespeare, Published in January Number . . . Presenting Further Evidence from Other X-rays

RARELY has a magazine article aroused such widespread interest as the one by Charles Wisner Barrell entitled "Identifying 'Shakespeare'" which appeared in our January number

Hailed by many readers as one of the most remarkable true detective stories of the time, the article was based on an investigation that its writer and his technical associates carried out with X-rays and infra-red photography on a series of ancient paintings long known to Shakespearean authorities as traditional portraits of the Bard of Avon

Through exigencies of space, Mr Barrell was obliged to confine his discussion to one of these paintings, the famous Ashbourne canvas, owned by the Folger Shakespeare Library, of Washington, D C

With the scientific media employed, he demonstrated graphically that the man who originally sat for this portrait must have been the mysterious Elizabethan Court poet and dramatist, Edward de Vere 17th Earl of Oxford

In his own day, Lord Oxford was known as the writer foremost "in the rare devices of poetrie" but, at the same time, one whose "doings" could not "be found out and made public with the rest"

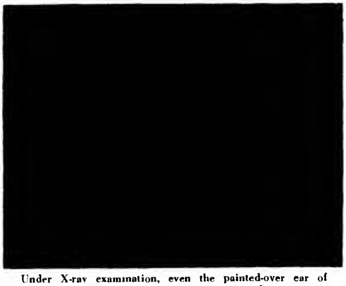
Of late years, his name has frequently been associated with the long disputed authorship of the Shakespearean plays and poems, beginning with the publication in 1920 of J Thomas Looney's scholarly volume, "'Shakespeare' Identified in Edward de Vere 17th Earl of Oxford"

Mr Looney's work won the endorsement of such scholars, historians and students of the Elizabethan period, as Dr Gilbert Slater of Oxford University, Dr Gerald H Rendall, former Headmaster of the Charterhouse School, Alan Gordon Smith author of "William Cecil, the Power Behind Elizabeth," Sir Geoffrey Callender, historian of the Tudor Navy and knighted for his writings on the Elizabethan Age, Dr Sigmund Freud, the psycho analyst, whose studies of the Shakespearean plays had a profound influence upon his professional theories, and John Galsworthy, the novelist, who helped distribute the book by Looney.

Since Lord Oxford's long-hidden career as poet and dramatist was first brought to light in 1920, more than 30 additional volumes of research and commentary relating to his life have been published

These facts are mentioned to make clear the point that, while Scientific American is not a literary or historical magazine, Mr Barrell has substantial corroborative backing for the conclusions that he drew from his X-ray and infra-red dissections and discussions of the ancient Shakespeare portraits

A close-up view of the ear from the X-ray photograph shown below



Under X-ray examination, even the painted-over ear of the Ashbourne Shakespeare agrees with other portraits

Moreover, while Mr Barrell submitted for our consideration some 75 X-ray, infra-red and panchromatic photographs, together with voluminous documentation covering his studies of the Hampton Court, the "Janssen" and the Ashbourne paintings of the Bard, it was a manifest impossibility to publish anything more than a digest of his material in one issue of the magazine It also seemed necessary to concentrate on a single set of the dissective photographs. Those relating to the Ashbourne portrait were chosen But equally interesting and telling evidence could have been used from the Hampton Court or "Janssen" paintings, which also indicate that they are disguised originals of the poet-Earl whose "doings" in the literary world of his own day were so difficult "to find out"

The Associated Press and other news syndicates treated "Identifying 'Shakespeare' With X-Ray and Infra-Red Photography" as a special wire feature As a result, versions of the story were printed in some 2000 newspapers news reviews and magazines throughout the United States and Canada Many of these items were given front page space In addition, many columnists, such as Walter Winchell Benjamin de Casseres, Joseph Henry Jackson of *The San Francisco Chronicle*, Ada Hanifin of *The San Francisco Examiner*, Harlow R Hoyt of *The Cleveland Plain Dealer*, and so on gave the Scientific American article much space From Maine to California and from Winnipeg to San Antonio, millions of newspaper readers had their attention called to the first discoveries of their kind ever announced in the field of Shakespearean research. Nearly a hundred prominent journals devoted editorials to the ensuing controversy. During one week, *The New York Times*, *The New York Post* and *The New York Sun* commented at length. On January

(*Please turn to page* 299)

OUR POINT OF VIEW

Proportion

IN his thought-provoking article on "Man's Earthly Future," concluded elsewhere in the present number, Professor Mather points out that, even though man now seems to have learned to control the environmental factors that invariably have exterminated other higher mammal species within 3,000,000 years, and thus may survive indefinitely, he may lose this ability and thus may end in the same oblivion as the rest.

Judging by comments heard here and there in conversation, many prefer to believe only the best They do not like to think of this old Earth which they call "ours" rolling on and on through space without the presence of man to adorn it and, as they put it, take care of it This earth with none to work the soil and fisheries and mines, none even to run away with Kentucky hordes of gold or bother to look at them, everywhere peace revolting thought

But if this old Earth had a consciousness and voice it might chuckle and say, "Oh, don't worry I hardly knew he was here. I'll get along fine I always did"

There is, however, sound scientific basis for the cheerful statement that if man became extinct men would evolve again from some of our cousins the apes If not, then from our more distant cousins the monkeys And if all the primates became extinct, more would evolve If all the higher animals became extinct, in time the same animals would evolve, provided the environment were the same. All this might take a billion years or so but what's a billion years in the course of cosmic time?

So man, modern man, civilized man, may be taking himself just a bit too seriously What he most needs here is a sense of proportion —*A G I*

No Block to Progress

RECENT controversy between the Federal Communications Commission and Radio Corporation of America brings once more to attention an important phase in the development of television Shall television transmission be commercialized — thus, as some hold, freezing television standards to the detriment of technical development — or shall commercial television programs be withheld and the art continue on an experimental basis?

Analysis of this problem requires some reiteration of what has gone before Detail in a received television image depends on the number of lines into which the original has been broken for transmission The receiver of course, must operate on the same line standard in order to reassemble the image so that it can be seen A receiver designed for operation on a 441-line signal, for example, cannot receive the images from a transmitter that is operating on a 605 line standard Then, too, television transmitters are costly to construct, expensive to operate. Television companies cannot continue experimental work indefinitely unless permitted to acquire some financial return on their investment And the only logical way to receive such return is to sell advertising time on the air, just as is done by sound broadcasters.

Opposite as these two factors of standardization and finance may appear, they are inseparably linked. A line standard must be set before a satisfactory system of commercial television can be established. And the 441-line standard that is being used by Radio Corporation of America is under fire as possibly not being the last word. Some commentators feel that an attempt to establish commercial television on this standard would result in the freezing mentioned before

Let's look at it this way In this writer's opinion, 441-line television is good. Sometimes it is excellent There is plenty of work for engineers to do, for some time to come, in improving the consistency of excellent reception, decreasing the times of poor reception And this work can best be done if a standard basis has been set up There will be one less variable for them to consider, one more fixed point from which to operate

If this fact can be coupled with an opportunity for the television companies to realize a return on their investment, the picture will look brighter With money coming in, they will be able to improve their service, produce better programs, make technical advances that would be impossible otherwise Without such financial support, television may languish in the laboratory for years to come It all boils down to this Good television is available now Let's make use of it, study it under wide-spread operating conditions, improve it as much as possible Setting a 441-line standard will not result in freezing progress Rather, it should result in tremendous acceleration —*A. P P*

An Unwanted Investigation

IF we are to believe the politicians, the Federal Bureau of Investigation is rapidly becoming an American Gestapo and the Bureau's Director, J Edgar Hoover, a ruthless dictator with insidious power. The politicians want to investigate the Bureau, having already made up their minds that private citizens can no longer look for justice at the hands of the Bureau

Of course, it may all have been a dream, but we seem to remember the wave of jungle law that swept over the country a few years ago Public enemies took their toll of human lives—including little babies who were kidnapped and murdered after ransom was paid Local peace officers were powerless, when into the fight stepped an organization that had long functioned efficiently but had never had spectacular chores to give it publicity before That organization cleaned up the "public enemies" down to the last unimportant individual

The Federal Bureau of Investigation, under the leadership of its greatest Director, J Edgar Hoover, indeed performed a spectacular task in a way designed to impress criminals of its power against them For the new sense of security which the Bureau gave to the country, that country is grateful Naturally, the Bureau gained a high and glorious esteem in the hearts of all Americans. Consequently it has been given the chance to expand and become more efficient In most respects, it is now the finest, most scientific, and consistently successful body of its kind in the world. Its record is spotless, for neither J Edgar Hoover nor any member of the Bureau can be bought or intimidated—never could he and never will be!

There are no political appointees in the Bureau, yet an investigation of it would put the Bureau into politics simply because Congressmen will necessarily take sides in the ensuing argument. This may be the intent of the politicians—in order to grab some of the Bureau's glory for their own party or to open up within the Bureau new patronage for party members. No matter what the reasons behind the proposed investigation, it would play into the hands of organized crime, for criminals would like nothing better than to see the Bureau's powers limited In any case, the whole idea is ridiculous, and if the investigation does go through, it is our firm belief that, not the Bureau, but the politicians will be adjudged guilty of Gestapo practices—by a public that is grateful for the work of its Federal Bureau of Investigation and J. Edgar Hoover —*O.D.M.*

Treasure In East Anglia

A Buried Anglo-Saxon Ship . . . Riches in Refined Gold and Silver Work . . . A Surprise to Archaeologists and Historians . . . Unearthed in England

By J. REID MOIR, F.R.S.
President of the Ipswich Museum Ipswich England

A DISCOVERY, unique in the history of western Europe, has been made in eastern England. The county of Suffolk is already renowned for its wealth of archeological remains, but the discovery of a royal ship burial beneath a tumulus or sepulchral mound at Sutton Hoo, near Woodbridge, is an event overshadowing in romantic interest all other discoveries in that part of England

When the Roman power, which for over 400 years had governed Britain, began at last to wane, enemy raiders, coming across the North Sea, started to invade that country The earliest of these were the Anglo Saxons, who were followed in later times by the Vikings, who burned and raped and pillaged to their hearts' content up and down the whole length of Britain's eastern seaboard. All these people were sea-rovers, and when their great men died they were buried in the ships which had carried them on their voyages in this world and would be used for a similar exciting existence in the next

Clearly, the idea of an all-pervading peace had not then entered men's minds. After the departure of the Romans from Britain, a period about which very little is known began, and without much doubt was characterized by increasing lawlessness, fighting, and disorganization. But it is known that, toward the close of the 6th Century, A D, Redwald, the third ruler of the East Anglian tribes, held sway in eastern England He died about 617 A D, and there are weighty reasons for believing that the treasure ship found at Sutton Hoo represents the grave of this warrior King

REDWALD'S history is of considerable interest Under the influence of King Ethelbert of Kent he adopted Christianity, but, on arriving back in Suffolk, is supposed, under the influence of his wife, to have reverted to paganism It is believed, however, that from then on he kept, as it were, a foot in each theological camp, and in his temple at Rendlesham, some few miles from Sutton Hoo, he caused to be erected two altars, one to the Christian God, and the other to the pagan deities If this is true, the nature of the burial found at Sutton Hoo becomes of much interest It was, in fact, aggressively pagan in character, and may represent Redwald's pagan interment, while his Christian burial may be elsewhere at a site not yet discovered In any case, no traces of human bones were found at Sutton Hoo, and, while this is possibly to be accounted for by the non-preserving nature of the soil there, it is equally possible that no body was ever interred in the tumulus, which represents a token burial to the high gods of paganism

The site at Sutton Hoo is on the north bank of the River Deben and is situated about 100 feet above the water. There are a number of tumuli at this spot, and, on the request of Mrs. E Pretty, the owner of the estate, who generously financed the work, Ipswich Museum had excavated, during 1938, certain of the smaller mounds. The archeological

© British Museum

A six-inch gold buckle, of horse's head design, from the Sutton Hoo burial chamber in the ship below

The western end of the ship discovered beneath a burial mound of earth at Sutton Hoo, England. The burial treasure chamber lay where the ribs are missing

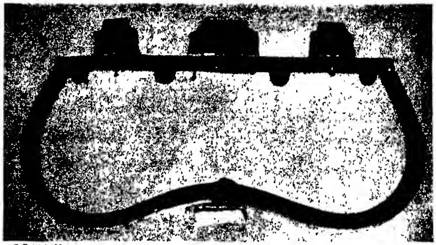
results of these diggings were interesting, though not spectacular, as definite signs of boat-burials had been found, accompanied by cremated bones and certain funerary objects These at the time were thought to be of Viking age but it was clear that the mounds examined had in all probability been dug into before, and it was not possible to decide with certainty the age of the burials from the scanty objects recovered

In 1939, work was begun on the largest of the burial mounds at Sutton Hoo, and it was not long before Mr. Basil Brown, in charge of the excavation, came upon evidence pointing to the

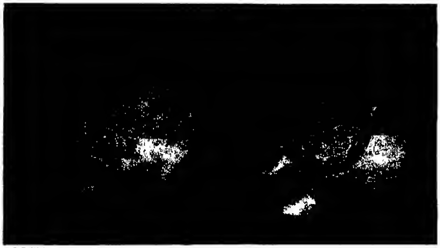
presence of a large ship underneath the tumulus Though very little of the actual woodwork remained, the original shape of the vessel was clearly to be distinguished by the rows of large iron rivets still in place in the sand, and the evident signs of the position of the ribs of the ship

She was 82 feet long, with a beam of 16 feet, and represented a more or less flat-bottomed rowing galley with 16 or 18 oars on either side. To the west lies the Deben Estuary, ready to bear the ship away on her ghostly voyage to the far distant spirit land

It is possible to conjure up the scene when the burial of King Redwald took place. Evidently it was a somewhat lengthy process. First, the preparation



© British Museum
Gold frame of the King's purse, with sliding catch and hinged strap fastenings



© British Museum
Two of the nested silver drinking bowls found with their nine drinking horns

© British Museum
A silver dish, 15 inches in diameter, bearing a female head in répoussé

of the trench for the ship, and later hauling it, by means of teams of horses and rollers, up the steep slopes of the valley side These things no doubt took time and were followed, in all probability, by funerary feasts and ceremonies of an elaborate kind.

All these matters are intensely interesting, but when we turn to the contents of the wooden tomb chamber in the center of the ship, these feelings change to amazement. The richness and completeness of the funerary objects in a measure compel comparison with those found in Tutenkhamon's burial chamber in Egypt Never before has such an array of beautiful gold and silver objects been discovered in a tomb in western Europe, and no one had any idea that the East Anglian Kings of 1300 years ago possessed treasures of the kind unearthed Clearly, the grave was that of a man and the richness of the funerary objects indicated that he was of the highest rank There were present his spears, axe, and sword, the golden pommel of which, and the massive boss from the center of the shield, were beautifully decorated with interlacing ornament and enriched with enamel

The excavator of Anglo-Saxon graves is usually more than content if his labors are rewarded occasionally with a brooch crudely set with garnets, or one or two imperfect spearheads. At Sutton Hoo, however, was a massive gold buckle, possibly from a magnificently decorated sword belt and nothing less than a masterpiece of Anglo-Saxon interlacing design Also two pairs of splendid clasp-plates, possibly used as armlets, with rich decoration of sliced garnets and millefiori glass inlaid and mounted in solid gold.

The great purse, of which the gold frame lay by the side of the presumed site of the body must, when entire, have been a magnificent object The sliding catch of the gold frame is in perfect condition, and the workmanship and design of this and other objects is a revelation of the supremacy of Anglo-Saxon and Frankish art at this period

One of the most remarkable finds is a great whetstone, or honing instrument, four-sided, with bearded faces cut in relief at either end, which also carried bronze cup mountings But, in addition to these war-like furnishings, the grave contained many silver objects for use in the celestial feasts A great Byzantine dish, made in Constantinople in the time of the Emperor Anastasius, lay to the east of the place where the body was presumed to have lain Beneath this dish, which bears inside its base the name and portrait of the Emperor, lay a silver dish 15 inches in diameter, bearing a répoussé female head in the center

In association with these were nine nested silver bowls, with the same number of drinking horns mounted in silver Thus the dead King was to be enabled to entertain in the world of the shadows, and to pay his way with the 40 gold coins and two small ingots of gold which were found close by his magnificent purse

It is impossible to describe all the funerary relics at Sutton Hoo the silver spoons the numerous objects of iron, some for culinary purposes, and the much decayed wooden specimens, one of which may represent a musical instrument All the relics are being treated and examined at the British Museum, under whose auspices the final stages of the excavation were carried out, and to which, by the generosity of Mrs. Pretty, all the finds have been presented

Archeologists are referring today to the Sutton Hoo discovery as the finest ever made in Great Britain, perhaps in Europe.—Editor.

Don't Worry—It Can't Happen

By JEAN HARRINGTON

JUST about a year ago, two German physicists who had been gunning at the metal uranium with neutron bullets, just to see what would happen, suddenly found that they had caused the biggest explosion in atomic history. It wasn't a big explosion in an everyday sense, no Berlin window panes rattled at the blast, and no one heard the noise. But it seemed big and loud to other physicists all over the world. They had never before known of an atomic blast of such tremendous energy, and presently they began to worry about it.

Scientific American, for October 1939, contained an article, "Two Atoms for One," which described the German discovery and the flurry of research and excitement which followed. The new phenomenon was called "nuclear fission," because Hahn and Strassmann, the two Germans, had found that their neutron bullets split the heavy cores of uranium (and a few other heavy elements) into halves.

Previous experiments had succeeded only in knocking chips off atomic nuclei and these operations released only a tiny fraction of the boundless energy locked up in atoms. But, when uranium cracked in two, 200,000,000 volts of energy burst forth in the form of radiation, heat, and speed.

Scientists have long wanted to convert matter into usable energy, and this was the biggest step they had ever taken in that direction. No matter that there was still an almost astronomical number of steps to be taken. Feverishly they began to attack uranium in their laboratories.

IT was soon apparent that quite a number of strange and wonderful things happened when the uranium nucleus blew up, as the accompanying diagram shows. Besides the two main fragments, a few spare neutrons (two or three per fission) were thrown off from the original nucleus. In addition, the two new atoms were unstable, erupting neutrons and other particles in a whole series or chain of reactions until they finally subsided. The result was a great hodgepodge of new atoms and extra neutrons.

Early last summer, in the midst of all this research, a chilly sensation began tingling up and down the spines of the experimenters. These extra neutrons that were being erupted—could they not in turn become involuntary bullets flying from one exploding uranium nucleus into the heart of another, causing another fission which would itself cause still others? Wasn't there a dangerous possibility that the uranium would at last become explosive? That the samples being bombarded in the laboratories at Columbia University, for example, might blow up the whole of New York City? To make matters more ominous, news of fission research from Germany, plentiful in the early part of 1939, mysteriously and abruptly stopped for some months. Had government censorship been placed on what might be a secret of military importance?

The press and populace, getting wind of these possibly lethal goings on, raised a hue and cry. Nothing daunted, however, the physicists worked on to find out whether or not they would be blown up and the rest of us along with them.

Now, a year after the original discovery, word comes from Paris that we don't have to worry—at least, probably not. Frederic Joliot, son-in-law of Mme Curie, and three co workers, von Halban, Kowarski, and Perrin, finally traced to its end the tumultuous course of the uranium fission chain reaction. They found that, instead of building up to a grand climax, it runs down and stops like an unwound clock.

Their method was to measure the total number of neutrons emitted in one of these chain reactions. The original fission liberates two or three. They found that the remainder of the chain produced five or six more, an average of eight for each split nucleus. If the process were cumulative there should be far more than that.

With typical French and scientific caution, they added that this was perhaps true only for the particular conditions of their own experiment, which was carried out on a large mass of uranium under water. But most scientists agreed that it was very likely true in general.

The key to the problem is probably the speed of the neutrons. In the original experiments it was soon found that relatively slow neutron bullets were the most effective in producing fissions. As the chain reaction proceeds, and more and more energy is released, the uranium target becomes heated. The extra neutrons are perhaps so speeded up by the heat that they cease to be efficient atom busters. Thus the reaction poohs out as the temperature rises.

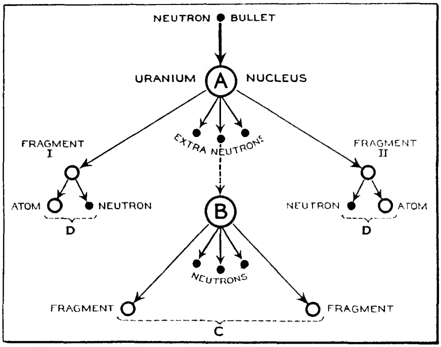
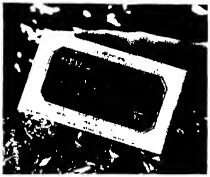


Diagram of a theoretical chain reaction for uranium. The neutron bullet at the top splits the uranium nucleus *A* into fragments I and II and, in addition, erupts three extra neutrons. One of the latter may hit another uranium nucleus *B*, and split it into similar fragments and neutrons *C*. Each of the first two fragments may break down into another atom plus a neutron, as at *D*. The total number of neutrons is eight. Readers made insomnious by "newspaper talk" of terrific atomic war weapons held in reserve by dictators may now get sleep

Packaged By Science

THE package in which a product is sold becomes more and more important Designers have tackled this problem with a vast amount of research in the effort to provide more attractive packages, packages that are more easily opened, and others that provide combinations of advantages not hitherto available On this page are shown a few of the 60 prize-winning packages chosen from more than 30,000 entered in the 1939 All-America Package Competition, sponsored by *Modern Packaging* magazine Some of them are startling innovations Offhand, one might imagine all these developments simply the result of certain ingenuity displayed by the sales force, but their ingenuity goes deep into the processes of scientific research None of them would be possible were it not that research departments have developed, for example, new films resistant to pickle vinegar, newer alloys resistant to fluids used in medical dressings, and new processes for handling and improving upon the uses of these and many other products

First wet, pre-medicated dressing, Tu-Ba Gauze, in a sterile tube Compact, for the first-aid kit, it holds a square yard of gauze wet with three ounces of medication A thumb nail cut opens it easily



Made of a heavier quality of the material Pliofilm, of which some women's raincoats are made, a new pickle pack—pickles and juice—is a limp bag inside the window box More convenient for shipping, store shelf stacking, and general handling, the bag is opened by cutting with a knife

Eye-catching beauty of ruffling in these transparent counter display containers is overshadowed by the protection against soiling and rumpling they provide The transparent material is Vuepack Clerks touch only yardage sold, inventory means counting remaining rows in containers

Lower Right Shoe polish in a collapsible tube which screws into base of a brush Squeezing the Shubador tube pushes shoe cream into the center of the brush. The cream stays fresh as it is not exposed, and the fingers do not touch the cream

A special award was given for the process made possible by this valve-headed can Corn is cooked in can in 30 seconds at high temperatures under vacuum. It is claimed to give a degree of flavor preservation never before attained in cans

Protection against contamination and loss of flavor is given to cheese by the transparent, inner bag While still hot and molten, the cheese is poured into a bag of Pliofilm which is then heat-sealed Other foods—coffee and the pickles shown above—are also hermetically sealed in this same material which is rubbery, slightly elastic

Railroadbed Highway

Super-Highway Across Pennsylvania Follows Old Railroad . . . Original Tunnels Utilized . . . No Sharp Curves . . . No Steep Grades . . . Speed With Safety

By F. E. WOOD

IN the forest fastness of Pennsylvania's mountains one of this country's last remaining frontiers is falling a victim of engineering achievement, as a small army of 10 000 workmen cuts through a "dream highway" that is expected to be the first link in a network of super high-speed motor roads from coast to coast

This four lane divided highway being built at a cost of $60 000,000, is called the Pennsylvania Turnpike Completed, the Turnpike will run 160 miles over an old wilderness trail that was cut through before the turn of the century by a railroad syndicate but never completed, and will use seven of the old tunnels Next summer, the Turnpike will be thrown open to the nation's 27,000,000 motorists, busses, and trucks as a speedy passageway through the Appalachian Mountains between Harrisburg and Pittsburgh

This highway is, however, more than just a super motor road It has military significance of prime importance The Turnpike will link Pittsburgh, seat of the nation's vast steel industry, with the eastern seaboard, permitting rapid transport of vital materials in time of war And although this factor is not stressed by the Pennsylvania Turnpike Commission, it is understood to be one of the major reasons that the Public Works Administration agreed to underwrite $26,000,000 of the road's total cost

At the instigation of the War Department the Bureau of Public Roads even now is making a detailed survey of this country's 3,000,000 miles of highway system from a military point of view ever mindful of the need for rapid transport of troops, guns, and supplies to safeguard our shores from enemy attack and protect inland strategic points

Although Congress has often been told that the country's present roadway system is adequate for the transport of troops, highway engineers point out that many improvements are necessary for movement of heavy artillery and other bulky military equipment Most of the high-speed roads constructed within the last five years have taken this into account, but, the engineers contend little has been done to construct roads thoroughly geared to military emergency demands

The Harrisburg - Pittsburgh highway is, primarily a commercial road, but its military aspects have been considered should the need arise for the rapid movement of troops between the two cities To augment this, engineers who designed the Turnpike planned for an extension of this new super highway to Philadelphia

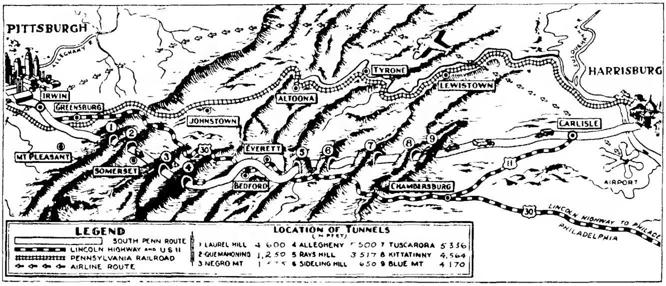
The Turnpike was routed so that it could utilize to the best advantage seven of the tunnels and most of the roadbed of the Old South Penn railroad that was started 60 years ago by William H Vanderbilt and Andrew Carnegie, who sunk $10,000,000 into their enterprise before abandoning it

Divided by a 10-foot parkway, the Turnpike is the most scientifically designed thoroughfare ever planned, its engineers claim By using seven of the abandoned railroad-project tunnels, the longest of which is a little more than a mile, steep grades are eliminated The maximum ascending grade will be no more than 3 percent, and curves will be long and sweeping, with a minimum radius of 1000 feet This design makes for a degree of sustained speed such as never before has been possible on other highways Maximum safety at maximum speed is allowed because at no point will a curve loom at the end of a long straight stretch or near the crest of a grade. A minimum of 1000 yards vision is assured at all times

One of the many rubber-shod pieces of construction equipment used

With a total length of 162 miles, the highway will pass through many cuts and over fills that make necessary the excavation of 26,000,000 tons of earth and rock Along the route, the seven tunnels to be utilized—named for the mountains which they cut through—are Blue Mountain, Kittatinny, Tuscarora Sideling Hill, Rays Hill, Allegheny, and Laurel Hill. Sideling Hill, the longest,

After a lapse of 50 years, the east portal of Tuscarora tunnel needed clearing before re-boring and widening. The original brick lining seems rather good



The Pennsylvania Turnpike will have great strategic importance—linking our greatest steel center with the eastern seaboard

Steel supports inside one of the re-bored and widened old tunnels

runs 6650 feet The others average slightly more than one mile in length

The old railroad tunnels most of which were only about half finished, are being bored to extra width and height to make way for the wider roadway They will be buttressed with steel beams concrete, and structural glass The Turnpike, running over a 200 foot right of-way, is graded 78 feet wide in the open, and narrows to 28 feet at the entrance to the tunnels On fills are 10 foot shoulders In the tunnels, cars will travel on two $11\frac{1}{2}$-foot lanes Of 176 horizontal curves, only 10 are of more than 4 degrees

Construction on the project is a race against time In order to qualify under the terms of the federal grant, the express highway must be "substantially completed" by June 29, 1940 And the engineers directing the gigantic task say it will be ready for the public by the Fourth of July If the road comes through on time—and with the pace already set, this seems assured—it will set a record for high-speed construction of high-speed highways

Because of the necessity for speed in building, the 27 contractors engaged on operations have moved onto the right-of way with the most modern excavating, grading, and road-building equipment Gone are most of the old fashioned steel-wheel earth movers In their stead are some 300 to 400 fast moving, rubber shod machines Some of the earth-mover tires, designed especially for this type of big-load operations, measure eight feet in height, weigh nearly 1000 pounds and give increased traction to the large excavators, some of which haul 30 cubic yards of earth and rock per trip

CONTRACTORS on the job report that rubber-shod equipment reduces operating costs as much as one-third and speeds up operations so greatly that the highway will be completed in one third the time it ordinarily would require with less modern rolling stock W H Elliott, technical director of design for bus, truck, and earth-mover tires for the B F Goodrich Company estimated that more than four-fifths of the machinery used by contractors on the 160-mile highway project is rubber-shod, bringing the total number of units to 1000

Never before have highway builders undertaken to tunnel a roadway through such a mountainous region The mountains range from 2000 to 3000 feet in altitude in some of the most picturesque country in North America Pennsylvania's other two major highways, the Lincoln and the William Penn, have solved part of the transportation problem in the state, but the rapid increase in traffic left these two roads inadequate to handle the greater volume The Lincoln Highway crosses the mountainous region with steep grades and sharp curves, and the William Penn follows the winding Juniata River and crosses one range the Allegheny escarpment

Scientific protection is given workers on this giant tunneling project Although Pennsylvania has no complete dust-control law, the Turnpike Commission is following New York's statute closely with mandatory wet drilling when the dust content of the tunnels exceeds the allowable limit

Altogether, 114 bridges will be built along the highway, and several viaducts will be necessary to elevate the high-speed Turnpike The 600-foot New Stanton Viaduct in Westmorland County is the largest of these spanning a 1400-foot-deep valley It will carry the Turnpike over two highways, a railroad, and a creek A trip over either the William Penn or the Lincoln Highways involves a cumulative total ascent of 13,000 feet while the total climb on the Turnpike will be less than 4000 In eliminating 10,000 feet of climbing, the Turnpike lessens the dangers of skidding on ice coated inclines

Because of the elimination of steep grades and a shortening of the route over the mountains to the eastern seaboard the Turnpike will save up to $27 for heavy trailer-trucks, the engineers estimate and a proportionate amount for light passenger cars Toll charges will range from $1 25 for motorcars to $10 for the heaviest trucks

Traffic engineers estimated when the Turnpike was designed, that 1 300,000 vehicles of all types will use the high-speed highway during its first year and that traffic will increase to more than 2,000,000 by 1945 This "yardstick" of future super-highways involves every known principle of engineering skill, and the many ideas tested in its construction will be valuable to undertakings on an even larger scale It gives America a send-off to a national network of super-highways to aid commercial, pleasure, and military needs of the nation.

EVEN THE EARTH ERRS

Man's Most Accurate Clock is the Rotating Earth but the Earth Goes Fast and Slow . . . Science Must Keep Eternal Watch on its Subtle Changes

By HENRY NORRIS RUSSELL, Ph.D.
Chairman of the Department of Astronomy and Director of the Observatory at Princeton University Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington

THE important error in a time piece is its error of rate; it keeps on getting more and more wrong from day to day Yet, though we demand relatively high precision of time measurements, both in practical matters and in scientific work, it is harder to get a good standard unit of time than of length or of mass Experts can construct a standard meter or standard kilogram with the utmost care and of the least perishable materials, compare it as accurately as possible with the international primary standard, and keep it in a vault at the Bureau of Standards, whence it is taken only rarely to test other subsidiary standards But we cannot keep a standard second, or day or year, in a vault at the Naval Observatory to be taken out when we want it We must catch time on the wing and can measure it only by the motion of some body, which is moving as nearly as possible under undisturbed and uniform conditions Our best clocks are kept in air-tight cases, in a partial vacuum, and in deep underground vaults, thermostatically maintained at a constant temperature, yet, despite the ingenuity of their design, their readings will not agree for more than a few weeks at a time It does no harm if one clock runs a little fast compared with the other, so long as it does so at a uniform rate This can be very easily allowed for, but, although such adjustment has been made, the readings of the best clocks begin, after a few weeks, to disagree by much more than the error of recording them

Better things may be hoped from the "crystal clocks" which depend upon the very rapid but very uniform vibrations of a suitably-shaped piece of quartz, under electrical stimulus Such a crystal reminds one of the advertisement that was sometimes seen in the days of primitive mechanical refrigeration "A cake of ice never gets out of order"

But we have a more easily available moving body, which gives us a scale for time measurement which surpasses in uniformity that of any device of human construction — namely the rotating Earth on which we live

The Earth is very big and very heavy, and is rotating freely as it moves in empty space The attraction of the Sun, which holds it in its orbit, has no influence at all on its rotation, neither has that of the Moon or the planets — with one reservation The differences of attraction of the Moon or Sun upon different portions of the Earth, which are known as tidal forces, cause the waters of the ocean to move over its surface, and these motions, when they produce currents in shallow water, are attended by friction This friction produces heat at the expense of the Earth's energy of rotation, and therefore tends to slow the rotation down It can be calculated, however, that a continuous frictional loss at the rate of a billion horsepower would cause a lengthening of the day by about a thousandth part of a second at the end of a century No humanly constructed clock can even remotely approach this degree of accuracy in running Our only chance of detecting so small a change in the Earth's rotation is to compare it with some other motion which is still less liable to disturbance — and this may be found in the orbital motions of the Earth around the Sun, and the Moon around the Earth These are affected, in a very complicated manner, by the mutual attractions of the three, and of the planets But these effects can be, and have been, calculated, and precise allowance for them can be made

The story has long ago been told in these columns how Fotheringham, by a careful study of the records of eclipses observed in classical antiquity, proved beyond a doubt that such a change has actually occurred, and that the Earth, considered as a clock, is very gradually running slower and slower

SINCE the era of telescopic observation began, other moving bodies, such as the inner planets and the satellites of Jupiter, have also become available as checks upon the Earth's rotation The Moon, which moves fastest in the sky, gives the best check

Now it has been known for a century or so that the Moon's observed motion did not agree exactly with the best calculations, but these calculations are so intricate that it was only the classic work of the late Professor E. W Brown which settled conclusively that the effects of the gravitation of all known bodies had been accurately calculated But the Moon, compared with Brown's theory, still shows serious and very puzzling deviations, which are not steadily progressive with the time but fluctuate irregularly Compared with the Moon's motion as a standard, the "clock" based on the Earth's rotation is sometimes fast and sometimes slow From the most recent discussion, by the Astronomer Royal, Dr H Spencer Jones, it appears that, after allowance has been made for the slow progressive change revealed by the ancient eclipses, the Moon was 13" (of arc) behind its calculated position in 1681, 15" ahead in 1785, even with it in 1863, 16" behind in 1898, 10" behind in 1920, and 16" again in 1935 Since the Moon takes 1.8 seconds of time to move a second of arc this means that our Earth clock was 23 seconds fast in 1681, 27 seconds slow in 1785, 29 seconds fast in 1898, 18 seconds fast in 1920, and 29 seconds fast in 1935 During the last part of the 19th Century, it ran fast at the rate of four fifths of a second a year, then it changed and ran half a second a year slow, 20 years later it began to run fast at about the same rate as before The observations suffice to show that these changes took place within two or three years; they can not be made accurately enough to follow the alterations from month to month

Such changes as this can not be explained at all by tidal friction (which can only *slow* the clock) unless we assume that the friction is usually heavy, and is "let off" at times when the Earth appears to run fast But any such assumption plays havoc with the ancient eclipse records, and demands that we believe that gigantic changes in the ocean tides and currents took place about 1898 and 1920, when mariners observed nothing unusual

There is but one solution to the puzzle — found by Brown — namely, that the *size* of the Earth is subject to change If the Earth should shrink uniformly by one part in a million its rotation would become more rapid, and the day would shorten by two parts in a million — as follows from elementary

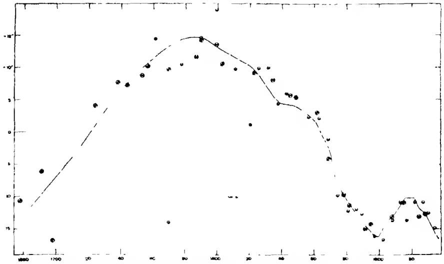
principles of mechanics The changes in the speed of rotation in 1898 and 1920 amounted to 1 3 seconds per year, or one part in 24,000,000, so that they could be explained if our planet at the former date (or within a couple of years of it) expanded by one part in 48,000 000 of its diameter that is, by ten inches — and shrank back to nearly its former size 20 years later These changes must have affected the main body of the Earth, and been fairly uniform, for otherwise sea-level would have been altered along the coasts No one has any idea what processes in the deep interior of our planet caused them, but the assumption that they happened accounts for the observed facts, and nothing else that has so far been suggested does so at all One check upon the hypothesis is possible If the "fluctuations" of the Moon's motion really arise from changes in the Earth's rotation and hence in our ordinary time-standard they should reappear in the case of every moving astronomical body which can be observed with sufficient accuracy These should all run ahead of calculation, or fall behind it, in the same years, and by amounts proportional to their own apparent rates of motion

This test has been applied by Jones in his recent paper The other astronomical motions available for a test are those of the Earth about the Sun (or of the Sun in the heavens) of Mercury around the Sun, as shown by the times of his observed transits and of Venus about the Sun

The discussion of material of this sort demands a thorough knowledge of the details of the observations which are considered For example, the apparent motion of the Sun may be studied either in an east-and-west direction (right ascension) or north and-south (declination) The former gives the larger observable effect, but it depends upon observations of the times of transit of the Sun's limb across the wires of a meridian instrument (its brightness being of course greatly diminished by suitable screening devices)

The personal equation or individual peculiarity of the observer in noting the moment when the edge of the great round disk just crosses the spider-thread, may be very different from that which holds good for the same man in watching a star — a mere point of light — transiting the same system A great many different observers were at work during the 170 years for which observations were observable, and their unknown personal peculiarities render the observations less trustworthy The declination observations, though not ideally accurate, are less troubled in this way Again, the observations of Mercury's transits are of greater weight than those of Venus, in the daylight sky

The net result of Dr. Jones' analysis



Fluctuations in the longitude of the Moon, from observations of the Moon, Sun and Mercury Reproduced from *Monthly Notices* Royal Astronomical Society

made with his characteristic thoroughness and accuracy is that the condition spoken of above is satisfied The other celestial motions show "fluctuations" in the same direction and at the same time as the Moon's motion, and these are of just the amount which would result if the Earth, as a clock was wrong to the extent indicated by the Moon's motion To be more precise, the observed and calculated effects agree within $2\frac{1}{2}$ percent, with a probable error of $3\frac{1}{2}$ percent The evidence that the fault is really with our Earth clock is therefore entirely conclusive

These conclusions are remarkable enough, and may some day be of great importance to geophysicists, in studies of the deep interior of our planet To the astronomers of the present and future they assign something more than a "life sentence of hard labor We must keep on observing the Moon's position in the sky as often and as accurately as we can without end, repose or rest Only by doing so can we keep account of the unpredictable changes of the Earth's size and of its behavior as a clock and only thus can we provide ourselves with a reliable time scale It is to be like poverty something we always have with us

These observations of the Moon were formerly made mainly with the meridian circle The difficulties of observing a large disk already mentioned are not quite as bad as for the Sun, but are still present, but the average deviation for a whole year gives a reliable value As a check upon these, photographic observations were initiated some 20 years ago A snap-shot of the Moon, in the middle of a time exposure on the surrounding stars was obtained by a very ingenious method devised by Professor F C Pickering These plates gave accurate determinations, but the necessary calculations were long and costly when hundreds of observations were desired — and the method has been abandoned in favor of a simpler one This is the old scheme of observing the occultations of stars by the Moon From the tabular values of the position and motion of the Moon the exact time at which she will hide a star of known position from an observer at a given spot on Earth can be calculated, and the discordances between these predictions and the observed times afford the desired evidence how far the Moon is ahead of prediction or behind

There are plenty of stars whose disappearance behind the dark side of the Moon can easily be observed with a telescope of moderate size, and amateurs as well as professional astronomers can make valuable observations in this way It is necessary of course, to know the Greenwich time — or other standard time — at which the star vanishes with an error of a second at the worst Before the days of radio this was not easy for the amateur to do, but nowadays enough accurate time-signals are available to enable anyone to check his clock or watch daily or oftener By collecting and working up observations of occultations, Professor Brown and Dr Comrie of London succeeded, in a very few years and at small expense in doubling the accuracy in which the position of the Moon was known (that is the average amount of its deviation from the tables for a given year) The calculations involved are simple enough but rather tedious but Brown and Comrie found that there were amateur computers as well as amateur observers who *liked* to work with logarithms, and, when provided with suitable instructions and blank forms did the calculations for pleasure

Amateur and professional astronomers, in co-operation, are thus adding yearly to our knowledge of things whose very existence was hardly suspected 20 years ago. — *Mount Wilson Observatory, February 28, 1940*

MAN'S EARTHLY FUTURE

RÉSUMÉ. *In the first part of the present article the author pointed out that the Earth is safe and will remain suitable for life for many more millions of years, that its present climate is not its typical climate, which has been and will again be more genial all over its surface, that man is an animal and that few species of animals have lasted more than two or three million years, the average being more like half a million years, and that our species,* Homo sapiens, *therefore should last that long. He also stated that most species of animals have gone down because of their inability to adapt themselves to altered environments, but that* Homo sapiens, *uniquely, has learned to control his environment through the clever use of material things. He has enough of some things for his use indefinitely but at present is using up others, such as petroleum, at a prodigal rate.*

The Earth's Natural Resources Should Suffice for Another Thousand Years of Civilization . . . The Outlook for Man is Far From Pessimistic

By KIRTLEY F. MATHER
Professor of Geology at Harvard University

(In Two Parts - Part Two)

ALTHOUGH petroleum affords an excellent illustration of the relation of non renewable resources to the activities of man, it is by no means typical of the items comprising nature's accumulated capital. For nearly all of the important non-renewable resources, the known world stores are thousands of times as great as the annual world consumption instead of less than a hundred times. But, for the few which, like petroleum, are not known to be available in such vast quantities, the story is much the same. Substitutes are already known or potential sources of alternative supply are already at hand, in quantities adequate to meet our current needs for at least two or three thousand years. There is, therefore, no prospect of the imminent exhaustion of any of the essential raw materials, so far as the world as a whole is concerned, provided our demands for them are not multiplied rapidly in the future.

That, of course, raises another question. Will the demand for non renewable resources increase materially in the future and thus hasten their exhaustion? Recalling the fact that the human population of the Earth has increased almost five fold in number in the last 300 years, we might well be fearful on that score. The study of current population trends, however, makes it readily apparent that the next few hundred years will by no means duplicate that record of the past. If present trends continue the all-time maximum population of the United States will be attained about the year 1970 and will total little more than 150,000,000 souls.[1] Thereafter except for possible influx of immigrants from other countries, no further increase in numbers is to be expected.

Accurate figures are available for only a few other countries, such as England, France, and Germany, but there is a strong probability that the all time maximum for the "white" races will be reached during the last third of the 20th Century and for the entire population of the Earth before the end of the 21st Century. Although the human family has doubled its numbers since 1860, it is extremely unlikely that it will ever reach twice its present number of approximately 2,000,000,000. The pressure of demand for non renewable resources will not, therefore, become acute because of the increase in population in the near future. Mother Earth is a very wealthy benefactress, and our heritage of physical resources is far greater than ordinarily supposed.

THERE is, however, another reason why current consumption of non renewable resources cannot be taken as the basis for computing the "life" of such stores of basic materials. The demand for automobiles, telephones, radios, airplanes, zippers, is today very unevenly distributed. Only a small fraction of the human population uses such things in any large amount. Other peoples are beginning to demand them and will do so increasingly as they become acquainted with the "benefits of civilization." In a few decades, unless we return to savagery, the world demand for many non-renewable resources will be twice or thrice that of today.

Taking all these things into consideration it would appear that world stores of needed natural resources are adequate to supply a basis for the comfortable existence of every human being who is likely to dwell anywhere on the face of the Earth for something like a thousand years to come.

Even so, there may be found here an excuse for the policy of "grabbing while the grabbing is good," which motivates many individuals and nations at the present time. That excuse might, of course, be offset by the suggestion that there is no need to take thought for a morrow a thousand years hence, if we have any respect for the ingenuity of our remote offspring. There is, however, another phase of current trends in human history that should not be overlooked in this connection.

One hundred years ago, something like 80 percent of all the things man used had their source on farms; most of the energy used to do the work of the world came from the muscles of living beings and from falling water. Today only about 30 percent of the things man uses come from things that grow, most of the energy with which work is done comes from petroleum and coal. For a century or more, the policy has been to use relatively less of the annual income and more and more of the stored capital.

Now comes the change. Automobile steering wheels are made from soy beans, piano keys from cottage cheese, innumerable articles fashioned of plastics are produced in part from corncobs and alfalfa, multitudinous metal and rubber substitutes are synthesized from various farm crops. Energy is transmitted at high voltages for hundreds of miles from hydro-electric turbines. A considerable portion of the annual budget for research is being devoted to progress in the direction of using more of the renewable resources—man's annual income and less of the non-renewable resources—nature's stored capital.

What this new policy will mean is readily apparent. With progress along such lines, the pressure for political control of metalliferous ore deposits, coal fields, and oil pools is lessened. Much of the physical basis for international jealousy is liquidated. At last the intelligence of science may make it truly practical to beat our "swords into

From the Eighteenth Sigma Xi Lecture delivered at the Columbus, Ohio convention of the American Association for the Advancement of Science

[1] Thompson and Whelpton, National Resources Committee "Population Statistics," Vol. I, 'National Data,' p. 9, 1937

ploughshares, our spears into pruning hooks."

Again comes the insistent question from the pessimistic critic Is there land enough? Is there sufficient fertile soil to provide adequate food and in addition the plant materials for the ever expanding chemical industries? And again we hear the same reply Yes, there is enough and to spare J D Bernal computes from apparently valid data that the cultivation of 2,000,000,000 acres of land by the methods now in vogue in Great Britain would provide an optimum food supply for the entire population of the Earth "Two billion acres is less than half the present cultivated area of four billion, two hundred million acres itself hardly 12 percent of the land surface of the Earth" And in this calculation no account is taken of the increased yields that may confidently be expected from the continuing research of agronomists, plant breeders, and experts in animal husbandry not to mention recent developments in the new science of the soilless growth of plants Evidently, the predictions of Malthus notwithstanding mankind need have no fear that increasing populations will place an impossible burden upon the available sources of food Human ingenuity intelligent use of renewable resources wise adjustment of structures and habits to environmental conditions seem competent to dispel that dread shadow

BUT these optimistic conclusions concerning the relation of man to the non renewable and renewable resources essential for comfortable existence are based upon world statistics Obviously they do not apply with equal force to the economy of individual nations No nation, not even the Soviet Union, Brazil, or the United States of America, embraces within its political frontiers a sufficient variety of geologic structures to give it adequate supplies of all the various metalliferous ores necessary as raw materials for modern industrial operations The United States, for example, must import nickel tin, antimony, chromium and platinum if American manufacturers are to use those metals in the fabrication of articles essential to what we are pleased to call the civilized way of life[6] Likewise no nation enjoys a sufficient variety of climatic conditions to permit all kinds of food-stuffs to be grown on its farms and fields or gathered from its forests, and to allow the growth of all the various plants contributing raw materials to industry The United States, again the most significant example for us, is forced to import all the bananas, coffee, tea, camphor, coconuts flax, jute quinine, rubber and shellac, consumed in this country, either from foreign countries or its own over seas possessions[7] It is entirely possible that within a few decades, substitutes of domestic origin may be available to take the place of many, or even all of such commodities or that plant breeders and agronomists may find a practical way of extending the geographical limits of some of the plants

"Fossils of two related, extinct animals of the Quaternary Period, 24,500,000 years ago The odd one at the left was for a time civilized, in a way of speaking" From an intelligence dated 25,000,000 A D

whose products are considered essential so that any nation occupying a large fraction of any continent may actually be self sufficient But for the present and probably for a long time to come it is evident that every nation is dependent upon many other nations for the raw materials that it needs for its own industrial prosperity

Perhaps the most important fact concerning the life of man today is this fact of interdependence No nation, community or individual can gain any lasting measure of security without taking that fact into consideration The resources that man must utilize, if he wishes to escape the fate of his less intelligent relatives now known only by their fossil remains are unevenly distributed and locally concentrated The techniques of discovering and utilizing them are now fairly well known, but satisfactory procedures for making them and their products available to all members of the human family are not close at hand

The very solution of the physical problems which man encounters in his attempt to maintain his foothold upon the Earth brings him all the more forcefully into bruising contact with psychical and spiritual problems that must also be solved if he is to continue his existence on this planet The critical question for the 20th Century is how can two or three billion human beings be satisfactorily organized for the wise use and equitable distribution of resources which are abundant enough for all but are unevenly scattered over the face of the Earth? Clearly, the future of man depends upon finding and applying the correct answer to that specific but far reaching question

Man is not only a specialist in the art of coordinated activity, but the trend toward organization is recognizable in the entire development of cosmic administration Electrons, neutrons, and protons are organized into atoms, atoms into molecules, molecules into compounds, some of the compounds prove to be cells, and these are organized to form individual plants and animals. Latest of all in the history of creative evolution certain individuals have been organized into societies Transcending all that has gone before is the development of human society, obviously the most difficult, but at the same time potentially the most glorious organization yet attempted

TWO antagonistic alternatives present themselves as possible bases for this organization The issue between the two has never before been so clearly drawn as it is today The social group, whether it be the family the industrial or commercial company or the political unit, may be organized on the principle of regimentation or it may be developed according to democratic principles Both methods are being tried under a variety of conditions, and each has something to be said in its favor But both cannot be equally conducive to the continuing existence of mankind One or the other must be selected as the basis for the future security of man

If regimentation be the choice then the great mass of humankind must be trained for obedience — blind, unquestioning, but superbly skilful obedience The educator becomes the intellectual and spiritual counterpart of the drill-sergeant in the army This is no menial task, nor is its objective a mean one Skill is a commodity of which there is never likely to be an over supply On the other hand, if democracy be the choice, the great mass of humankind must be trained for wise, self-determined co-operation Precisely those qualities of mind and heart which have long been extolled in Christian doctrine must be developed to the fullest possible extent Not only skilfulness but also the ability to govern oneself, the eternal prerequisite for freedom, must be de-

[5] J D Bernal, 'The Social Function of Science New York 1939, p 347

[6] Brooks Emeny, "The Strategy of Raw Materials,' New York, 1937, p 26 and chart facing p 29

[7] Ibid pp 28-37

veloped in each member of the group.

In so far as physical existence is concerned, there would seem to be little or no choice between these alternatives. Perhaps, human nature being what it is today, the regimentation of society may temporarily be the more efficient method. But the full circle of organic law embraces more than mere existence. From the continuity of the evolutionary process, there has emerged a creature who is aware of vivid values in life that may be found beyond the goods necessary for comfortable existence. Ideas and ideals are powerful determining factors in the world today, and among them the ideal of freedom for the individual in the midst of social restraint is the most vital and compelling of all. Though it baffle our scientific tools for measurement, it is none the less a reality.

IT is in the yearning for freedom, the love of beauty, the search for truth, the recognition of moral law and in the awareness of spiritual forces that human nature is distinguished from all other sorts of nature. Man shares with other animals the need for satisfactory economics, for adequate food and shelter, for the goods essential to existence, but his needs transcend these physical factors because his nature differs from theirs.

Regimentation may be good for man as an animal; through that type of social organization his need for goods may be efficiently supplied. But regimentation is certainly not good for human nature as thus distinguished. Experience verifies what wisdom foresees, regimentation stultifies the spirit, destroys personality, standardizes thought and action. Worst of all, regimentation means stagnation of the creative process and, as we have seen, stagnation among the more complexly organized vertebrates has led inevitably to extinction. If man attempts to live by bread alone, mankind commits collective suicide. Apparently the best and perhaps the only chance for mankind to succeed in the quest for security is through progress in the art of living on a high spiritual plane rather than through exclusive attention to the science of existence on a purely physical level.

To put this same thought in more specific terms, it means that coordinated activity directed toward efficient organization of individuals must become co-operative activity directed toward the enrichment of personality within an efficiently organized society. This requires both intelligence and good will.

Fortunately these characteristics are uniquely developed in the species of placental mammal with which we are preeminently concerned. Man is a specialist in the use of both. The trend of the past 5000 years may well continue, despite numerous temporary setbacks, throughout the next few centuries at least.

It is sometimes suggested that because man has specialized in brains, brains may cause his downfall, just as presumably the overspecialization in external armament contributed to the downfall of certain herbivorous dinosaurs. That argument by analogy is, however, heavily punctuated with fallacies. There is as yet no evidence that mankind is weighted down with a superabundance of intelligence. On the contrary, it is failure to act intelligently that endangers individuals and groups in the midst of competition. To see in advance the remote consequences of contemplated action is an ability which ought to be increasingly cultivated rather than scouted as a menace.

There seems to be no good reason why a sound mind should not be accompanied by a sound body. If the number of psychopathic individuals is increasing in this high-speed, technologic age, it is a challenge to be met not by bemoaning the imminent collapse of civilization but by intelligent adjustment of habits and activities to the new demand of the new times.

The roots of self-centered individualism may be traced backward for at least 600,000,000 years in the record of geologic life development, whereas our heritage of social consciousness dates from a time only about 60,000,000 years ago when gregarious instincts became clearly evident among placental mammals. That trend is, however, especially apparent in the group from which mankind has stemmed.

Man is still in the stage of specific youth. His "golden age," if any, is in the future rather than in the past.

In thus seeking a satisfactory co-ordination of intelligence and good will it becomes necessary for research scientists to give more thought than has been customary in the past to the social consequences of their work. They share with statesmen, politicians, educators and all molders of public opinion the responsibility for determining the uses to which the new tools provided by scientific research are put. As scientists they should continue to seek truth regardless of its consequences and to increase human efficiency in every possible way, but as members of society, as individual representatives of a species seeking future security as inhabitants of the Earth, they must also do their utmost to ensure wise use of knowledge and constructive application of energy.

THERE is a real difference between the so-called "social sciences" and the "natural and physical sciences" that has an important bearing here. It is not that there is anything "unnatural" about the social sciences. Man is a part of nature, and the study of human society is just as truly "natural science" in the real sense of the term as any other study. The difference arises from the peculiar factors and particular functions pertaining to the co-operative way of life. Whereas the scientific use of things may be achieved through the efforts of a very small minority of the citizens, provided with adequate facilities for research, the scientific organization of society in a democracy can be achieved only when the majority of its citizens have the scientific attitude toward social problems and act in accordance with that attitude of mind. In other words, only a few physicists, chemists and technologists are required for the mastery of our physical environment, but for victory in the struggle with ourselves every man must be his own sociologist.

Although this places upon the forces of education a Herculean task, it is not nearly so impossible an assignment as at first glance it might appear to be. In the first place, the responsibility upon the individual citizen is rarely that of designing a new social structure or charting a new program for society. Almost invariably it is his duty merely to select from many plans, programs or proposals the one that seems to him most likely to produce the most desirable results for all concerned. In the second place scientific habits of mind have already been developed to a greater extent than is ordinarily recognized. The garage mechanic attacks the problem of a balky automobile in a truly scientific manner. The salesman uses psychology in planning his approach to a difficult prospect. The housewife thinks scientifically when about to concoct a new dessert or redecorate the living room. In most cases, it is only necessary to apply in the area of social relationships the same habits of mind that have been followed in the area of individual behavior.

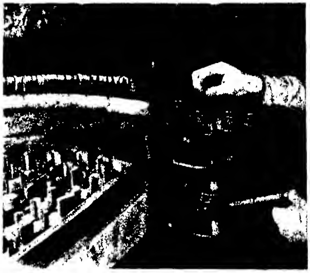
In conclusion, the outlook for the future of man as an inhabitant of the Earth is far from pessimistic. If certain tendencies already developing are encouraged and certain resources already available are capitalized to the full, there is good reason to expect that mankind will maintain existence and even live happily for an indefinitely long period of time. The opportunity is his to demonstrate the intrinsic worth of biologic phenomena and thus to justify the vast expenditure of time and energy involved in organic evolution. With greater emphasis upon the development of intelligence and good will, he may achieve that which the temporarily triumphant dynasties of the past have failed to achieve. Thus the geologist may turn from the long perspective of geologic history to the enticing vista of the geologic future of Earth and man with high hope and even with confident assurance.

Fish Hooks of New Alloy

RUST proof and high in strength are fish hooks now being made in a wide range of sizes, of "Z" nickel, a heat treatable alloy that is approximately 98 percent nickel. The alloy gives through-and-through corrosion resistance.

1 Coils of "Z" nickel wire are delivered to the hook manufacturer. The wire is first straightened and then cut into correct lengths for the hooks to be made. Then the short blanks are fed automatically over the surface of a grinding wheel (*above*) where the point is fashioned. One wheel carries the blanks along, grinding wheel is at right angles

2 After the point is ground, as shown in the photograph at the upper right, a special hand-operated cutter is employed to form the barb. The alloy of which these hooks are made is the first available material that combines the quality of being rust proof with the physical properties required in manufacturing satisfactory fish hooks



3 *Right, above.* The pointed and barbed blank is now bent around a die to provide the proper hook shape. Separate dies, shown in the left foreground of this picture, are employed for the different hook sizes and designs to be produced. At the time of writing, these new alloy hooks are being made in five different sizes, from tiny flounder hooks to the large sizes used in tuna fishing, in the O'Shaughnessy style

4 *Left.* After the wire blank has been pointed, barbed and bent to shape, another special machine turns the eye. Fish hooks, small in themselves, constitute a million-dollar-a-year industry. About one third of the hooks used in the United States were imported last year, and most of these were of the higher qualities. The new nickel hooks are expected to capture a large part of this market formerly served by importation from abroad

5 While there are several ways of testing hooks, many craftsmen producing high-quality hooks prefer to make their tests by hand. Experience has taught them to gage accurately the force that each size of fish hook should be able to withstand

EMPLOYEE HEALTH PAYS DIVIDENDS

Dusts, Fumes, Chemicals, Cause Worker Illness . . . Concerted Drive Against Such Hazards . . . Preventive Measures Also Against All Sickness

By JOHN F. McMAHON
Executive Assistant Air Hygiene Foundation

ILLNESS is industry's biggest bill! In the heavy industries, employing some 15 million persons, the average male worker loses about eight days a year because of sickness The average woman worker loses some 12 days There is approximately 15 times as much lost time from illness and home injuries as from industrial accidents such as cuts and broken bones

For every day lost by a skilled worker it has been estimated that the employer loses one and one-half, or maybe twice the amount of the worker's daily wage

If we take eight days as the average amount lost yearly per worker and multiply this by the 15,000,000 workers in the heavy industries, we get the staggering total of 120 million lost work days And if we consider $5.00 as the average daily wage, and one and one-half times this, or $7.50, as the employer's loss, then we get the dizzy sum of 900 million dollars as industry's annual bill for sick absenteeism This covers only heavy industry, about *a quarter* of our total work-a-day population. Nor does this figure include the losses suffered by the workman, the cost of health work sponsored by management, the compensation costs, and the like. Dr C. O. Sappington, in his "Industrial Health — Asset or Liability," estimates the total cost of sickness in American industry at 10 billion dollars annually

AIR Hygiene Foundation, an organization of industrial concerns for the advancement of employee health, has launched a sweeping study of sick absenteeism among its 200 member companies In a preliminary survey Dr A J Lanza, Chairman of the Foundation's Medical Committee, points out that respiratory diseases, notably the common cold, accounted for 44 percent of the male and 47 percent of the female disabilities among employees of a number of companies studied by the U S Public Health Service Another source finds that colds alone account for about three lost days per worker Encouraged by the dramatic success of the Safety Movement in reducing accidental injuries, the Foundation believes that by organized effort, corresponding progress can be made in reducing sick absenteeism

In fact, on an individual basis, numerous alert companies have worked wonders in reducing sick absenteeism by attention to preventive measures and by keeping accurate records of lost time.

R. H. Macy and Company inaugurated a new program of preventive medicine in 1926, and has since expanded it The National Industrial Conference Board reports that Macy's total absence rate from all causes declined 46 percent between 1928 and 1937 The medical department points out that if the company experience for the past 12 years had been relatively the same as in 1926, there would have been 156 more deaths, $21,938 more paid in death benefits, $347,445 more paid in sick benefits, 8369 more resignations because of poor health, and 631,769 more work days lost

After installing adequate medical supervision, another company reduced lost time by 8000 working days in the second year—an estimated saving of

Courtesy Mine Safety Appliance Company
Sand blasting of industrial products is a highly dusty operation. Workers so engaged are protected by hoods while they breathe clean air through a small hose

$29,094—and by 16,000 days in the third year.

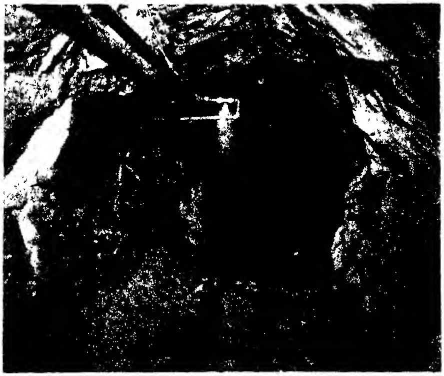
The whole problem of health in industry is as old as industry itself, yet it failed to stir the American mind until the silicosis furore of four years ago Hippocrates, "the father of medicine," was one of the first parents of industrial hygiene He wrote about the diseases of tradesmen in the 5th Century B.C., describing metal workers as pale and subject to respiratory ills.

Cleaners and dyers of antiquity used stale urine for cleaning purposes (Because of the foul odors they were forced to work outside the walls of Rome) These tradesmen suffered certain infections which Hippocrates described Rome also recognized mining as a highly hazardous occupation Instead of sending "public enemies" to concentration camps, the offenders were sentenced to work in the pits This usually amounted to the death penalty

LONG before the discovery of America, "chimney sweep's cancer" flourished in the cities of old Europe where boys and frail adults earned their living by removing soot from clogged flues In so doing they encountered chemicals in the soot which caused cancerous growths

Occupational ills are created and then eliminated by the forward march of man Chemicals which were "laboratory curiosities" a few years ago are now sold in carload lots for use in industry. Dr Carey P McCord says some 2000 different chemicals or work conditions may endanger health unless controlled Whizzing power drills replace the time-honored pick and shovel Spray guns supersede the paint brush These innovations cause air impurities, harmful dust, fumes, gases, and vapors, chiefly responsible for illness in industry.

Portable air-sampler (electrical precipitator) which registers presence of dangerous fumes and dusts in industrial operations. Note workman's respirator



Compressed air-water atomizing spray used for humidifying mine air. This Laird type spray is also used to eliminate dust and gases caused by blasting

The Foundation's Preventive Engineering Committee, headed by Prof. Philip Drinker of Harvard, has issued a series of brief engineering "cook books," giving ways and means for combating many toxic substances encountered in industrial atmospheres, such as benzene, carbon dioxide, chromic acid, lead, sulfur dioxide, and others Silicosis, which can now be controlled, is caused by breathing the powdery, flour-like, silica dust arising from many manufacturing processes.

Silicosis gets the publicity—they're even writing poems about it now—but tuberculosis is of greater concern to industrial management. J S. Whitney, studying tuberculosis death rates among men gainfully employed, has found:

Occupational Group	*Death Rates per 100,000*
Professional men	26 2
Proprietors, Managers, Officials	43 2
Clerks and kindred workers	65.8

Agricultural workers	46.5
Skilled workers, Foremen	72 1
Semi-skilled workers	98.2
Unskilled workers	182.0

Home and community conditions are heavy contributors to this disease. Hence some companies extend their medical services beyond the factory gates in the form of community clinics, care of school children, and similar services Under the able leadership of Dr. C. D Selby, General Motors has been doing fine co-operative work with local health departments to halt tuberculosis

Lead is another health hazard encountered in many trades "Painter's colic" is one familiar manifestation Andrew Fletcher, Vice President, St Joseph Lead Company, and Vice Chairman of Air Hygiene Foundation, tells how his company overcame the lead hazard

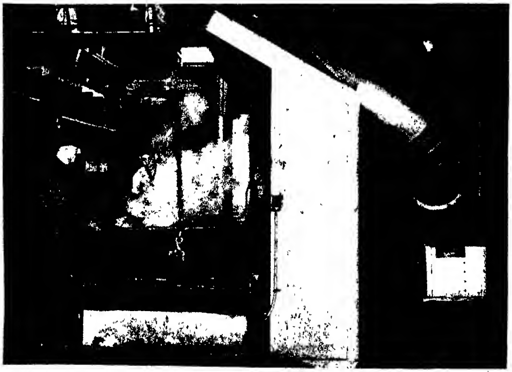
"At our smelter there were 64 lead poisoning cases in 1920 in an organization of 400 employees A study was made on the hazard, and as a result semi-annual general physical examinations and weekly physical inspections were instituted, a modern change room and a cafeteria were provided Arrangements were made for employees to wear work clothing supplied and laundered by the company, and all employees were advised as to the importance of personal cleanliness in combating the lead hazard A resident doctor not only examined the men, but also made periodic plant inspections to check conditions that might adversely affect health As the result of careful supervision lead poisoning is no longer a problem As a matter of fact we have not had a case of lead poisoning for the last 10 years "

In 1918, this company had a labor turnover of 250 percent, that means it had to hire 250 new men each year to keep 100 on the job. By intelligent attention to employee health, working environment, and community conditions, St Joseph Lead reduced the turnover to 3 6 percent in 1938. To illustrate the economic saving alone, the management figures that it cost approximately $100 to replace one workman

IN the sintering operating at a Pennsylvania smelter, a dust prevention and recovery plant was installed at a cost of approximately $26,000 Disregarding the greatly improved working conditions and employee satisfaction, the minimum saving per year is over $5000, and, therefore, the installation will pay for itself in less than six years But the same plant furnished a more striking example of making money when it spent some $13,000 in improving working conditions in the furnace basement As a result, it is estimated that the recovery in the furnaces has been improved by over 1 percent This saving may seem very small, but it is one which will more than pay for the operating cost of the installations, refund the entire $13,000 investment in one year, and show a profit of about $13,000 each year there after

Bunker Hill and Sullivan Mining and Concentrating Company, a member of Air Hygiene Foundation, installed two solariums at its Kellogg, Idaho, operations "Sun treatments" are available for underground workers and towns people Stanley A Easton, President, describes the work this way.

"Repeatedly I have been asked to report what good has been accomplished in the 10 years of our experience. Such results, while undoubtedly good, are difficult to express statistically, especially in the case of adults School children are brought to the solarium in the school bus in large numbers Superintendent of Schools John Booth has caused to be kept a record of time lost by the school children on account of illness He reports that the children who have used the solarium regularly show far less loss of time than those who take it irregularly or not at all The School Nurse reports the same thing, and that the solarium is almost a specific in the case of eczema and other skin ailments, in improving anemic children and those who lack appetite and natural vigor We give about 7000 treatments a month from October until May Adults who take the solarium regularly report in most instances entire freedom from colds and, almost universally, much lighter colds when they are afflicted A matron has charge of the solarium for two hours each morning for the use of the women and girls from whom we have similar reports Pneumonia during the late winter months is often prevalent, and in some years fatalities are high, records show that during 10 years there has been only one death from pneumonia by a regular user of the solarium, the victim being an old man in poor physical condition generally Some users of the solarium have had pneumonia but in a slight form The solarium is so well regarded by our people that we were petitioned to put one in at the smelter for the greater convenience of the employees at that plant which is somewhat remote from the mine This installation was recently completed and is already being used by a large number of our employees at the smelter and their



Considerable dust arises from the "shake-out" of castings in foundries In this foundry, all the dust is drawn into the wide hood before the shake-out table and exhausted through the large pipe

Photograph courtesy Claude B Schneible Company

families. I might add that my own experience largely confirms the foregoing. I take the solarium treatment regularly and am practically free from colds, or any other ailment for that matter"

Weary workmen are easy marks for illness and accidental injuries Some companies noticed that accident rates soared in late morning and afternoon Westinghouse Electric and other firms harkened back to school days for the solution, reviving the recess idea Now they have "snack periods" when lunch carts wheel through the plants and workmen can get a bite The "pick me ups" have stepped up production, reduced accidents and illness One Pennsylvania manufacturer instituted two 15 minute rest periods, one in the morning and one in the afternoon Although this shortened the work day by half an hour production jumped 20 percent A Toledo manufacturer who tried the plan reports a 12 percent increase in production despite a 6 66 percent decrease in working time

IT is well known that salt tablets have helped banish heat prostrations where workmen are exposed to high temperatures Glucose, a source of energy, combats fatigue Some plants make gum drops available, but one Pittsburgh steel mill had this experience workmen "hoarded" the drops Instead of eating the candy they took it home to their youngsters

Space forbids listing the many companies that are active in conserving the health of their employees The U S Public Health Service and U S Bureau of Mines also are doing valiant work in this same field Both agencies are represented on the Foundation's Board by Dr R R Sayers and Dan Harrington, respectively Government is increasingly active in industrial health Theodore C Waters of Baltimore, noted authority on occupational disease legislation and member of the Foundation's Legal Committee, advises that 24 states and the District of Columbia have now passed laws granting compensation for occupational diseases Arkansas, Idaho, and Maryland enacted such laws during the past year Meanwhile, commissions have been named in New Hampshire, Oregon, Tennessee, Texas, and Utah to study such legislation and report to their Legislatures this year Some 30 states as well as several cities, including Baltimore, Detroit, and St Louis have established industrial hygiene bureaus The courts hold, and properly, that the employer is responsible for the health of his employees.

It was the growing difficulty of meeting this obligation that led to the formation of Air Hygiene Foundation. A year before the silicosis sensations of 1935-36, organization details were being worked out by energetic A W Sherwood, Toledo glass executive, Dr E R Weidlein, Director, and Dr W A Hamor, Assistant Director of Mellon Institute, Dr H B Meller, international authority on air pollution, and a committee of industrialists headed by Roger A Hitchins of Philadelphia The Foundation is a kind of partnership of industry and science Some 200 companies, employing about one million workers, subscribe to the work About half the funds go in the form of research grants to Harvard, The Saranac Laboratory, and University of Pennsylvania

Fumes from molten lead can be a cumulative, slow poison. The workman shown here is safeguarded by the powerful ventilator at rear which draws off fumes

This research gets down to fundamentals The work at Harvard, under Prof Drinker, deals with engineering measures — exhaust systems, for example — for combating health hazards through control of potentially dangerous dusts and fumes

The research at Saranac and Penn deals with intricate medical investigations, such as "protector" dusts that clump with silica and drop it from the air or render it innocuous, the effects of dusts and fumes on lung tissue; and the improvement of X-ray methods for mass medical examinations of employee groups. Dr. Leroy U. Gardner noted authority on silicosis, directs the Saranac studies, while the work at Pennsylvania is under personable Dr Eugene P Pendergrass, one of America's foremost X-ray specialists.

From its headquarters at Mellon Institute, Pittsburgh, Air Hygiene Foundation makes plant health surveys for member companies, issues a monthly "news service" digesting latest industrial health literature, distributes medical, engineering and legal information and carries on numerous short time studies and membership services.

Safety would never have scored its triumph on the basis of individual companies all working independently, however fine their unrelated efforts It was the Safety Movement that did the trick Similar unified effort by employers is a prerequisite of progress in industrial hygiene. Prof Drinker designer of the iron lung, says industrial illness of all kinds is caused by a combination of environment and ignorance Employers are steadily improving the working environment. Air Hygiene Foundation, through its studies and services, is helping dispel the ignorance by advancing knowledge on an industry-wide front

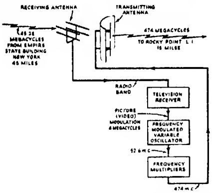
TELEVISION RELAYED

Makes Possible Network Systems . . . Test Operation Shows Feasibility . . . Uses Directional Transmission of High Frequencies . . . New Tubes

By A. P. PECK

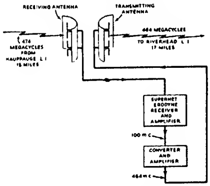
TELEVISION signals, confined as they are to the ultra-short waves, have an inherently short range Regardless of the power of the transmitter, the characteristics of the waves used limit the practical service range to the optical horizon This brief statement sums up one of the greatest problems which engineers have faced in the development of television for general public use It is impracticable to establish television networks using telephone land lines, as is done in sound broadcasting The high frequencies and the broad frequency bands demanded by high-quality television transmission cannot be carried satisfactorily on wire lines of the usual design

Thus the engineers have turned their attention to the possibility of radio relay stations which would give satisfactory and consistent service and would handle the frequencies needed With such relays properly spaced, it would become possible to establish television networks whenever and wherever the public demand became sufficient



An experimental radio relay system has been in test operation for nearly a year between the National Broadcasting Company's Empire State Building transmitter and Riverhead, Long Island. Each relay station contains both receiving and transmitting devices, mounted on a tower The antennas are of the parabolic type necessary for the highly directional, or beam-like, transmission which the system uses The distance between each relay point, in practical operation, would vary according to the terrain The average distance would probably work out at approximately 30 miles

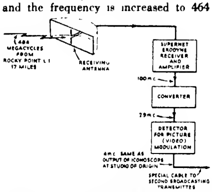
Radio relay stations used in the test are located at Happauge and Rocky Point, Long Island, making available at the Riverhead terminal programs sent from the television transmitter on the Empire State Building in New York City. Power for the stations, which operate unattended, is supplied from the nearby public service sources. In the event of failure of such sources, the individual station will automatically switch to use of its own emergency power supply, and change back to the first source again automatically when power service is restored. Operation of the relay stations may be started and stopped by radio signals sent over the circuit.



Development of a new, "inductive" type of radio tube has made possible the reliable transmission of very high frequencies with a radiated power of less than five watts, between relay points separated by 25 to 50 miles. In this tube, energy is derived from a stream of electrons without their coming in actual contact with active parts of the circuit, which gives the device the ability to handle with unprecedented efficiency very wide band widths at extremely high frequencies.

The first relay point of the new system is at Happauge, Long Island Here the television signals radiated from the NBC television transmitter in the Empire State Building, New York, at a frequency of 45 25 megacycles, are received and "detected," to provide the video (television) component, the band width of which is four megacycles This is used to control a transmitter with multi stages of frequency tripling, embodying recent developments in frequency modulation At its first stage of conversion into centimeter waves, the video component is employed to frequency modulate an oscillator producing 52 6 megacycles, at the second stage, the frequency becomes 158 megacycles, and in the final stage it is 474 megacycles

At the second relay station, the signal is received at 474 megacycles and converted to 100 megacycles, after which it is passed through a multi-stage amplifier which increases its energy to about one watt This energy is fed to an inductive tube operating as a converter, and the frequency is increased to 464 megacycles After passing through another inductive type tube used as a straight amplifier in the final stage, the 464 megacycle wave is sent out



At the final station in the relay link, the signal is received at 464 megacycles and converted to 100 megacycles, as in the previous station. After being amplified it is passed on to a second converter, where the frequency is further reduced to 29 megacycles, to provide a more favorable ratio between the frequency and its video component, for purposes of detection. In the process of detection, the signal is changed from its characteristic of frequency modulation to one of amplitude modulation. After further amplification at the video frequency, it is then ready to pass along to a second television broadcasting station, where it may be employed to modulate that station's transmitter, operating on one of the channels, between 44 to 108 megacycles, allocated to television broadcasting service.

The outstanding characteristics of the new relay development are the very high frequencies employed, and the new tubes used to produce such frequencies.

Rail Fissures Give Up Secrets

ONE of the greatest railroad track hazards known today is the internal transverse fissure which occurs in rails If rails containing such fissures are not found and replaced by good ones, these faults are capable of causing rupture of rails while in service and possibly disastrous results True, there are relatively few railroad accidents which might be attributed to such faulty rails but those that have occurred have been serious

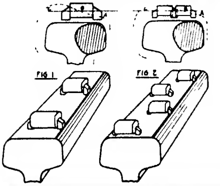
Some years ago the Sperry Detector Car was developed by Dr. Elmer A Sperry in co-operation with the American Railway Engineering Association. This car was first used in 1928 Its equipment consisted of a generator which introduced current into the rails over which the car travels, via two sets of copper brushes — one on each side of the car Each of these brush clusters carried a searching unit consisting of a pair of electrically opposed coils mounted midway between the current brushes and directly above the rail head

Current flow was unimpeded through sound rail, but when a fissure was encountered the consequent change in magnetic flux caused a "paint gun" to squirt white paint on the rail at the location of the fissure Later hand testing of that particular rail found the exact point of the break, and the rail could then be removed

While the idea is not new, such improvements have been made on the detector cars and they have been used so much more widely that remarkable progress has been made in the important business of locating dangerously defective rails in railroad tracks For example, in 1934 22,818 defective rails were found in 41 151 track miles—an average of nearly one bad rail in every two miles of track In 1935, 25,437 such rails were found in 61,860 track miles, and a steady increase was made through the years to 1939, for which year the figures were, respectively, 47,966 and 82,250 During the 11 years from November, 1928, through December, 1939, the Sperry Railway Service has tested over 549,000 track miles and have found over 279,000 defective rails This is indeed a startling record

How important is this testing for rails which might cause wrecks is shown by the fact that trains have been speeded up tremendously in recent years, the rails must carry heavier axle loads and are subject to the wear of greater traffic density And too many rails have been in service too long, the average annual replacement of rails, 1929 to 1939, being 897,000 long tons as against an average of 2,137,000 long tons per year from 1926 to 1928 inclusive

Multi-fissured rail is the most dangerous of track defects. Nearly 12 percent of fissured rails found are multi-fissured Four transverse fissures were in this two foot piece



Left **The early Sperry searching unit had two pairs of coils—in line (Figure 1) It often missed fissures to one side Modern type (Figure 2) has multi-tandem, staggered coils *Below* Main brush carriage of detector car Between two sets of current brushes is searching unit. *Right* At the paint spot, a hand searching unit, two rail contact points, and a meter mounted on rear of car, determine size of internal fissure. Each rail flaw, indicated by a paint spot, will be examined in this manner**

Making Tissues Ageless

Experiments on Tissue Cultures and on Portions of Plants . . . Suggest Promise of Artificial, Earthly Immortality . . . Direct Bearing on Medicine

By BARCLAY MOON NEWMAN

ONCE it was thought that aging is a universal characteristic of life — and that, in order to live, it is necessary to age. Now, to every one's satisfaction, it has been established that at least small portions of the body may be kept alive endlessly, agelessly Man has discovered the secret of immortality — for bits of tissue, at least A fresh nutrient medium keeps tissue fresh, youthful growing Every passing second does not necessarily leave an indelible imprint on living flesh

For more than a half-century, it has been possible to maintain life, for varying numbers of days, as strips sliced from bodies dying but not yet dead throughout Human flesh, still living even if cut from a body legally dead, will more or less lengthily stay quick in dilute salt solution very similar to sea-water, hence very similar to the salt solution which floods our veins Or such bits immersed in plasma — blood minus corpuscles — will likewise cling amazingly to vitality More than 40 years ago, human skin was held alive in tissue fluid, for weeks, and then successfully transplanted Then, within the next few years, cancer tissue was being cultured in dog blood, also for weeks

IN 1907, Ross G. Harrison reported a simple but revolutionary technique whereby bits of tissue can be made to live for several weeks outside the organism He took lymph from a young animal and touched drops of the fluid to the under-surface of small, extremely thin, glass plates The lymph drops clung and clotted Into the clots he introduced fragments of embryonic tissue He protected each culture by suspending the hanging drop over a small depression in a glass slide And, as the days passed, he saw nerves grow out through the clots — grow from embryonic nervous cells In a drop whose minute bulge looks down into a glass hollow, many a mystery of life is discoverable Thus at the very outset, Harrison taught men that a nerve cell can develop its own conducting thread, or axon

Thus also he gave a hint to the genius of Alexis Carrel It has been the genius of Carrel to extend indefinitely the life activities that can go on in a hanging drop And Carrel has invented flasks and fluids at last achieving the perfect result — artificial immortality of minute groups of cells.

In either hanging drop or flask, a coagulum is prepared from blood plasma A liquid nutritive mixture must also be provided If extraordinary precautions are taken against infection with microorganisms, and if the bit being cultured is transferred every two or three days to a fresh, sterile medium, ageless life is gained Growing tissue must be chopped in half at the time of transfer, otherwise the mass of cells becomes too bulky to permit inflow of nutrient and outflow of waste A living mass merely in the state of survival, rather than in some phase of growth, needs no slicing.

In 1912, Carrel cut a tiny piece from the embryonic heart of a chick and immersed the fragment in warm, nutrient bed, plasma being the source of nutriment as well as coagulum-support Then commenced a regular series of transfers to regularly prepared, fresh medium But the bit of connective tissue, though maintaining its life, slowly dwindled and promised eventually to perish, after several months in the series of flasks The seeker after terrestrial immortality thereupon thought to test the influence of fluid extracted from chick embryo — embryonic tissue extract Success! The long-living fragment began to wax as its cells multiplied healthily Consequently, this discovery, plus an almost infinite capacity for taking pains, means potential immortality for numerous sub-cultures of the original piece of connective tissue from the chick's embryonic heart As Carrel tells us

"The cell colonies remain indefinitely in the same state of activity They do not record time qualitatively In fact, they are immortal " [1]

Ageless they will remain, as long as laboratory assistants care for them

Recently, new methods have been introduced for the cultivation of larger masses of tissue, including human tissues of practically every kind, especially tumor cells. In 1936, G O Gey and M K. Gey reported their invention, the roller-tube system, for the maintenance of human normal cells and tumor cells in continuous culture Thin-walled test tubes are used, their walls being coated with plasma to which the living colonies adhere. Nutrient fluid within the test tube bathes the filmy layers of cells

[1] Carrel, A Physiological time, *Science* 1929 618 December 18, 1931

Photographs courtesy United States Public Health Service

An operation for removal of a tumor. After removal the tumor can be cultured in a special medium (see text) or transferred for culture to a living animal

One of the steps in tissue culture, conducted under sterile conditions

-- streams over them as a motor revolves the test tube rack six times an hour Fresh fluid is provided after four days Transfer to a fresh tube, with new coagulum, is effected after a week or a month, depending upon the nature of the culture Other techniques devised by Carrel and Raymond C Parker, at the Rockefeller Institute for Medical Research, New York, by W H Lewis and several other pioneers, permit a wide choice of procedures by which a large variety of animal, including human, cells may be given deathlessness far beyond — indefinitely beyond — the present average span of life of the whole creature Terrestrial immortality for almost any part of the human anatomy is nowadays only a question of money to cover the cost which is high

THE methods are sure and, moreover, are steadily being improved, as the vast and growing list of valuable discoveries bears witness At the Strangeways Research Laboratory at Cambridge England, from embryonic dental tissue whole rat- or rabbit-teeth are grown, without the jaw being present If human tooth-germ cells were available, from these microscopic specks entire human teeth could be synthesized in the test tube — the main factor being merely the appropriate nutrient mixture Factors controlling the production of blood corpuscles, controlling growth itself, controlling the rate of wound healing, regulating cartilage development, factors regulating success in grafting — an apparently endless list of factors — are being measured and evaluated. All medicine benefits

The relation between blood pressure and the thickness of the arterial wall is being elucidated, to the benefit of the considerers of arteriosclerosis, great tragedy of older man. "In grafting experiments with tissues derived from races of different size, genetic rather than immediate factors have been shown to be the more influential," the editors of the *British Medical Journal* (December 31, 1938) relate. They continue

"The Strangeways Laboratory is now even better equipped than before for studying the effects of radiation, and work has been done on the degree of susceptibility to X-rays of different processes in cell metabolism The factors controlling the effects of irradiation have been studied in tadpoles, and the results appear in several ways to confirm the long-held belief that metabolic activity and in particular the imminence of cell division, determine the susceptibility of the cell to irradiation All the work has evidently a fascination in that it deals with living material which is yet under complete control"

The editors could add that these determinations have direct bearing on medicine of today and tomorrow extending the practical limits of grafting learning the main secrets of success in treating cancer by irradiation finding the means of molding tissue cultures to the plan of man rather than of a wild Nature. And in the background is the stupendous basic discovery, tissue in glassware can by man be cultivated limitlessly Further, as we shall see protoplasm's plasticity can be in glassware more astonishing than anywhere else

By a method distinctly different from tissue culture, it is now possible to give agelessness to life, for very long if not endless periods. Animation may be suspended indefinitely by careful freezing and subsequent maintenance of a constant very low temperature — minus 70 degrees centigrade Whole organs or whole animals cannot so be preserved alive — at least as yet But practically any type of cellular mass, if not too large, may be frozen and after long periods revived successfully At Cornell University, C Breedis and J Furth have been keeping all sorts of cancer tissue frozen for as long as a year without any diminution of virulence after the thaw

Cells lining the windpipe have beating, hairlike cilia Breedis and Furth froze chicken's ciliated cells After 327 days, warmth made many cilia beat again, as though in the animal's wind pipe.

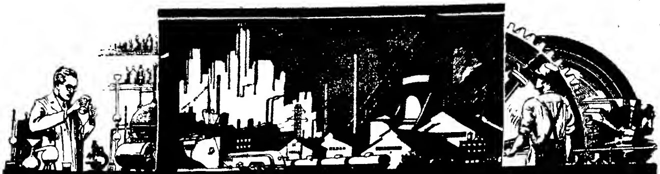
Tissue to be frozen is removed immediately after the animal is killed It is minced in nutrient solution and placed in small test tubes, which are then sealed with a flame Storage is under alcohol in a Thermos bottle containing large pieces of solid carbon dioxide ("dry ice"). The thaw is effected by shaking the test tube in warm water. The secret lies in slow freezing, rapid thawing, otherwise, death results

HOW long may life exist as suspended animation, frozen? Nobody knows P Ehrlich has found cancer cells still living after two years, though stored at the fairly high and unfavorable temperature of minus 8. Research is actually just beginning in this line New ways are being tried And even present ignorant technique serves to store frozen life indefinitely, ageless Nevertheless, the point here is not merely the potential development of perfect agelessness though suspended — frozen — animation, it is, further, the obvious, additional aspect of the lability of life, life so modifiable by man As the decades and the centuries pass, protoplasm's plasticity will emerge as a consideration far vaster in import than any possibility of artificial immortality

Plant-tissue culture too is practiced Carl D. LaRue, of the University of Michigan, is able to tell us

"In the course of recent work, I have observed numerous examples of a surprising length of survival of plant tissues Various parts of flowers were detached and placed in sterile culture on nutrient agar. Some of these parts have undergone no regeneration and have shown no significant growth but have lived many times as long as similar structures on normal plants Most of the structures were still vital at the end of the recorded period"

Petals of *Tradescantia paludosa* fall into decay within a day or two after flowering. So it goes in Nature, but not in LaRue's laboratory "In culture they remained alive for an entire year" Suspended animation? Probably not. rather was normal life abnormally maintained Youth and beauty need not fade — not so soon, even today Tomorrow?



SCIENCE AND INDUSTRY

A MONTHLY DIGEST

Conducted by F. D. McHUGH

Contributing Editor
ALEXANDER KLEMIN
In charge, Daniel Guggenheim School of Aeronautics, New York University

GLYCERINE FROM PETROLEUM

GLYCERINE is vitally important in a wide range of industries This sweet and viscous liquid is a by product of the soap industry and the quantity available is more or less fixed, depending, of course, on soap production Unlimited quantities of the compound can now be made from petroleum, according to a report by Dr Evan C. Williams, Dr H P A Groll, and G. Hearne of the Shell Development Company This new process may go a long way toward preventing the wild and unnecessary fluctuations in market price of this commodity

In the new process, propylene, a gaseous component of cracked petroleum, is acted upon by chlorine to produce at low cost allyl chloride Trichloropropane is readily prepared from that compound The molecule of trichloropropane is similar in structural design to that of glycerol (or glycerine), and the product is readily convertible into glycerol with the aid of cheap alkali

ELECTROSTATIC IRON ORE SEPARATOR

A LARGE percentage of iron still remains in iron ore discarded at the mines because of too low a concentration for commercial separation To prevent this waste an experimental electrostatic separator is being developed which shows promise of much higher operating speeds as well as more efficient and effective recovery of iron When this is perfected and put into use a much lower percentage of iron will be lost in discarded ore

NEW LOCOMOTIVE RECORD

A NEW all time world record for continuous railroad locomotive performance is believed to have been set on February 25 when Diesel electric locomotive No 56 pulled into Washington with the *Capitol Limited* of the Baltimore and Ohio Railroad This arrival marked the 365th daily run of the locomotive between Chicago and Washington without a miss, for a total of more than 280,000 miles So far as is known no locomotive of any type ever before has established a record of 100 percent availabilty in such gruelling service for a solid year

The record is regarded as being the more remarkable because it was made on a 772 mile run calling for regularly scheduled average speed of more than 56 miles per hour —including ten regularly scheduled stops—over a route which includes some of the heaviest mountain grades in the eastern section of the country The Capitol Limited regularly consists of from 11 to as many as 15 standard weight Pullman cars, ranking it with the heaviest fast schedule passenger trains in the country

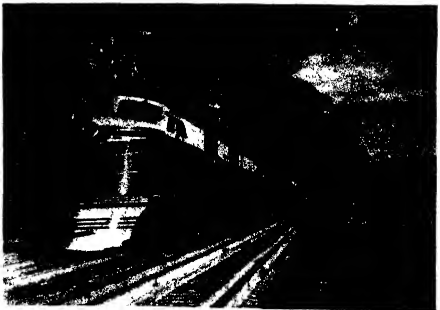
STATIC-FREE RADIO SETS

RADIO manufacturers will soon announce special lines of relatively static-free, high fidelity, radio receiving sets equipped to receive programs transmitted by stations that have adopted the Armstrong system of wide swing, frequency modulation broadcasting The sets will be designed to receive present standard band broadcasts as well as programs broadcast by stations equipped and licensed to use the patented Armstrong frequency modulation transmitters.

Claims for frequency modulation by Major Edwin H Armstrong, widely known radio engineer and inventor, include full musical-tone-range reception without distortion, and elimination of natural and man-made static The development of frequency modulation broadcasting and reception during the last 12 months has reached the present stage where licenses are being issued to radio broadcasting stations for installation of frequency modulation transmitters

BENZEDRINE IN ALCOHOLISM

THE treatment of alcoholism is more and more being understood as properly belonging in the realm of psychotherapy, even though the practitioners of this branch of medicine are somewhat discouraged by their efforts The chronic alcoholic addict has a fundamental personality defect which is extremely difficult to change but failure may be due to the fact that the proper psychoanalytic approach has not as yet been found Nevertheless it is possible to obviate some of the physiologic and psychologic after-effects of acute inebriation



Holder of an all-time world record for continuous service

quickly and effectively by the judicious use of benzedrine sulfate.

According to Reifenstein and Davidoff, who have investigated the action of this drug in mental states characterised by depression or self-absorption, acute alcoholic psychosis and Korsakow's syndrome in alcoholics respond well to the use of amphetine sulfate. Acute intoxication, with its attendant boisterousness, can be made to disappear rapidly by the use of this drug. A "hangover" is soon dissipated, both in acute and chronic alcoholism. When the patient is institutionalized, the results are even more striking.

These authors impress us with the futility of this drug as a cure for addiction to alcoholic beverages. Somewhat analogous to vitamin B deficiency therapy in the treatment of alcoholic polyneuritis, benzedrine sulfate merely improves the psychotic and physiologic aberrations which attend acute intoxication. Neither has any effect in altering a habitual tendency toward inebriation. Reifenstein and Davidoff cannot agree with Bloomberg who found that the use of this drug in chronic alcoholism permitted a sufficient period of sobriety for the institution of psychotherapeusis. Nevertheless, it appears that this drug has a definite place in the therapy of some phases of acute alcoholism.—*N. Y. State Journal of Medicine.*

Portable Device De-odorizes Air

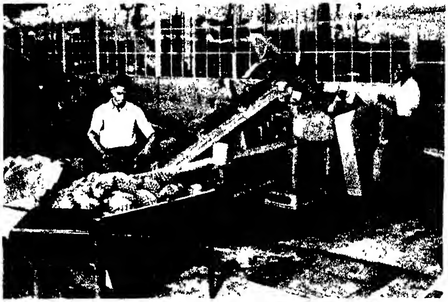
A NEWLY invented portable odor adsorber, employing the principle of the ordinary gas mask, is now available for removing unpleasant odors, gases, vapors, smoke and fumes from the air of theaters,

The fan draws foul air through the cylindrical container, where it is purified and delivered to the room

restaurants, offices, factories, hospitals, lavatories, and other places of human occupancy. The device, known as the Dorex "Squirrel Cage" Odor Adsorber, is simple, compact, and has but one moving part—the electric motor which draws the foul air in, purifies it, and delivers it back into the room.

Employing the positive extraction principle of air-odor removal, the Dorex unit uses an adsorption medium composed of a specially processed, highly activated, granular, coconut-shell carbon. One of the most powerful adsorptive agents known, it is able to adsorb and hold all condensable gases and vapors with which it comes in contact. This activated carbon is contained in a cylindrical cage of closely spaced, perforated metal cylinders.

Two types of these new units are offered by the makers, the Dorex Division of the W. B. Connor Engineering Corporation—one for installation on any wall or ceiling where it occupies little more area than an ordinary fan, and the other to be applied to any existing ventilating or air conditioning systems.



Preparing pineapples for canning at a rate of more than one per second

RAY-ABSORBING GLASS

AMONG the many types of glass developed in recent years is a unique one used in welding. It transmits only 3/10,000 of 1 percent of visible light, which is sufficient for seeing the brilliant arc, but it absorbs 100 percent of the ultraviolet, which is harmful to sight, and all but 1 percent of infra-red. Twenty-five years ago, only one commercial welding glass was available and this absorbed only 75 percent of the invisible rays.

Pineapple Peeler

BEFORE the new Ginaca machine was used in pineapple canneries, these Hawaiian fruits were peeled by hand. A good fast worker could average only three or four fruits a minute. Now, the largest cannery in the world, by using 46 machines, has a production record of preparing the fruit and packing 2776 cans per minute. This totals 3,497,388 cans per day or a car load every two and one-half minutes.

In 1910, an inventor named Henry Ginaca was hard at work on a machine which would peel the skins from pineapples. His aim was to do away with the slow and costly hand method.

The first Ginaca machine quadrupled the output. In addition to peeling the fruit, the machine shaped it in uniform sizes for canning. By constantly improving the machine, the number of operations it could perform was increased, as well as the speed with which it worked. By 1913 the Ginaca machine was peeling more than 30 fruits a minute; it sized them, took off the ends, and removed the core. However, it still did not scrape off the pineapple meat from the skins.

The present Ginaca machine can prepare from 85 to 100 pineapples a minute, depending on the size, and do it more perfectly than by hand. The shells are removed, ends cut off, the fruit is sized to uniform roundness, the core is accurately extracted so the hole is in the exact center, and the meat is scraped from the shell.

When Mr. Ginaca first got the idea for his invention, he was employed by the Hawaiian Pineapple Company. Now this concern uses 46 of his improved machines.

First Colchicine-Made Flower

A NEW flower, Tetra Marigold, which is introduced this spring to American gardens, is unique from the scientific, commercial, and horticultural angles. It has the distinction of being the first flower produced for cultivation which was developed by doubling the chromosome number by artificial means. David Burpee, plant hybridist, reports that in experimental work at the Floradale Farms, Lompoc, California, "dozens of species of plants have been used in our experiments to double the chromosome number through the use of colchicine. In many instances, no results whatever were achieved. In other cases, tetraploids were produced which were definitely inferior to the original plants. In other instances, larger and more rugged plants than the

Burpee and Tetra Marigold

Two views of the experimental set-up for testing aircraft fire-fighting equipment

diploids on which the work was done were produced, but the first one to respond satisfactorily to the treatment on a large scale is the new Tetra Marigold, produced by treating the most popular variety of African Marigold, Guinea Gold Seeds of the new flower are now available

Tetra Marigold has larger flowers of a more intense orange than Guinea Gold and the petals are frilly and possess unusually heavy substance which assures longer life for the flowers after cutting The plants grow two to two and a half feet tall and are very vigorous The main trunk and branches are thick and heavy, while the flowers are borne on short stems in clusters of six or eight on the end of the branches, each branch making a bouquet in itself when cut Blooms appear in about 19 weeks from the time seed is planted, and the Tetra Marigold is as easy to grow as other Marigolds —*C F Greeves Carpenter*

Baby Clipper

PIPER Aircraft, manufacturers of the well known Piper Cub, have undertaken an ambitious experiment by building a Baby Clipper One of our photographs shows a trim little amphibian which, equipped with a 75 horsepower engine, cruises at 92 miles per hour, carrying two occupants and 50 pounds of baggage The stalling speed is 45 miles per hour, and the cruising range is said to be 600 miles Gross weight is 1500 pounds, wing area is 180 square feet If small private land planes have reached such a high degree of popularity, then it may confidently be expected that a small amphibian or flying-boat, moderately priced, will be received with equal enthusiasm by private owners —*A K*

Aircraft Fire Prevention

THE Aircraft Section of the Technical Development Division of the Civil Aeronautics Authority (the correct, if unduly long, title) is pioneering in co operation with the Bureau of Standards in the field of fire prevention in the aircraft power plant Aeronautical research has a way of centering on the beauties of aerodynamics and structure and it is gratifying to see attention being given to less "beautiful" but equally essential research.

The general program involves the investigation of fire detectors, fire extinguishers, fire-resisting materials, and fuel and oil ignition A long and exhaustive program of tests is in progress with co operation of all interested manufacturers

The experimental set up is indicated in two of our photographs The power plant unit consists of a Pratt & Whitney Twin Row Wasp with a controllable, three bladed Hamilton propeller Back of the power plant is the nacelle and wing in almost full scale A wind tunnel will draw air in through a large opening, and will give a blast of 75 miles per hour on the power plant

In the test program it will be possible to vary the speed of the blast of air, the intensity of a simulated fire, the location of simulated fire the type of fire extinguisher, the type of fire detector —*A K*

Flight During Lightning Discharges

IN the *Journal of the Aeronautical Sciences*, E. J Minser, meteorologist of T W A, discusses this subject with a wealth of experience and observation to back his views Modern metal airplanes, carefully bonded and shielded, suffer little structural damage when struck by lightning—though there is always a hazard The first lightning discharges encountered were generally considered freaks of nature "one in a million" events But as their occurrence became more frequent, a general warning was issued to pilots to keep clear of thunderstorms This warning, wise as it appeared, did not decrease the number of discharges encountered Analysis of such events soon revealed that the majority of discharges were not being encountered in thunderstorms but occurred in "cumulus" type of clouds that produce showers The results of the investigation indicated that the airplane "triggered" a discharge between two cloud masses

As soon as it was determined that the initiation of a lightning discharge through an airplane in flight requires the passage of the plane between two oppositely charged portions of a cloud, much more specific instructions were issued to pilots

1 Avoid, if possible, instrument flight through large cumulo-type clouds, especially when the temperature is between 25 and 35 degrees Fahrenheit

2 If temperature and degree of static and corona discharge indicate the presence of a highly charged zone, reduce speed and descend

3 If change in altitude is not possible,

> **NON-STOP**
>
> **AERONAUTICAL engineers predict that within 18 months airplanes will be capable of flying to Europe with a full load and returning non-stop if necessary**

A Baby Clipper, designed for the popular-price class

keep eyes focussed on the brightly lighted Instrument panel This will prevent temporary blinding if a discharge occurs near the cockpit —*A K.*

SYNTHETICS

ORGANIC chemists of the world made approximately 25,000 new chemical compounds last year, an increase of about 6 percent

Pressure Cooker Sauce-Pan

THE many advantages of pressure cooking in an aluminum vessel have been incorporated into a standard aluminum sauce-pan by Vischer Products Company Made in four sizes from one to four quarts, the Vischer Flex-Seal Pressure Cooker cooks foods in a fraction of the time ordinarily

required It enables the housewife to use cheaper cuts of meat satisfactorily, and boasts the well known good qualities of aluminum cooking utensils Meats and vegetables retain their color and vitamin content when cooked under pressure

The new pressure kettle has no hold down bolts, gages, and extraneous rigging, yet holds a pressure of 15 pounds safely A thin, strong metal cover is inserted within the lips of the kettle, and is held down by an ingenious and easy to fasten hook As steam pressure is built up in the kettle, the cover is held down more tightly, and pressure-cooking takes place.

Self-Powered Hand Stroboscope

AS explained in our February article on stroboscopes, "Stopping Time," a rapidly rotating, vibrating, or oscillating object, seen very briefly at the same point once during each cycle, appears to be motionless because each time it is briefly viewed, an impression is made upon the retina of the eye and is transferred to and retained by the brain until the next glimpse This phenomenon, known as "persistence

Self-powered stroboscope compared with baseball for size *Upper right* The instrument in operation

of vision," has been used for years in various types of stroboscopes, from the ordinary slotted disk type to the type which flashes a light at regular, fast intervals to illuminate the moving object at one particular point of its cycle Commercial strohoscopes have depended mainly on the latter principle of light flashes

In the Strobomeca, a development of Boulin Instrument Corporation, the slotted disk principle is utilized in a hand instrument which is self-powered, requires no electricity of any kind, either from batteries or wire connections This new device contains a Chronometric motor which drives a slotted disk The speed is accurately controlled by a spring governor The motor, wound by a permanently attached key, the disk, protected by a heavy glass panel, and the governor are contained in a three-piece, threaded aluminum housing slightly larger and heavier than a baseball In use, the instrument is wound and focused on the moving object and then synchronized with the motion of the object, the speed of the object then being read on the instrument's graduations

The range of this instrument is from speeds of 500 to 100,000 and it may be used at the plant, in the field, indoor and out No accessories are needed It is claimed that the accuracy of the spring-wound movement has proved its durability in endurance tests of over 100 hours

FREIGHT-FUEL

FOR every thousand tons of freight and equipment moved one mile, American railroads now use 112 pounds of fuel compared with 172 pounds of fuel in 1920.

Paint for Hot Metal

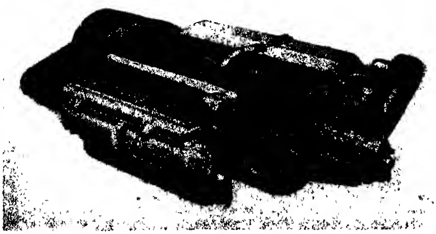
HOT metal surfaces are as subject to rust and corrosion as are cold ones but no ordinary paint can be used to give them proper protection A new chemical rust-preventing paint, named Kemick, has been developed for such hot metal surfaces This finish, which is made by the American Chemical Paint Company, may be used on hot parts of the automobile engine, such as exhaust manifolds, exhaust pipes, and mufflers. Not only will it protect the metal but it also makes a more sightly engine

Kemick becomes effective through chemical action with the metal which it covers. Whereas ordinary manifold and engine enamels decompose quickly and completely when subjected to heat, Kemick decomposes only partly, the volatiles are expelled, and chemicals are liberated to react on the metal surface It does not burn off but retains its color and protective properties and is said to improve with heating

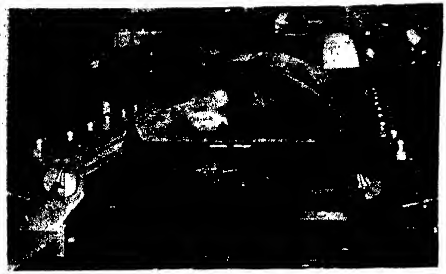
A Pancake-Design Diesel Engine

FOR reasons of economy of space, primarily, certain gasoline engines have been built with all cylinders horizontal, in what is known as a pancake design These have the important advantage of conserving space by being installed flat under the floor of truck bodies

This design has now been applied to Diesels by the Hercules Motors Corporation in a series of high-speed heavy-duty engines They were developed particularly for applications where limited space requires engines of limited height. Naturally, in placing Diesel cylinders horizontal, much attention had to be paid to a number of special prob



Space conservation is one advantage of the pancake-type Diesel

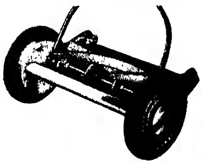


Sheet-metal forms are made by stretching on this press

lems involved, but it is claimed that these were all solved in this design The three models in the present series are of 176, 191, and 193 horsepower respectively

Silent Lawn Mower

MODERN lines and silent operation are the outstanding features of the 1940 Marathon lawn mower styled by Glenn W Tammen of Designers for Industry, Inc, for the F & N Lawn Mower Company



This modern mower will be approved by users because of its lightness and ease of operation, and by owners and neighbors alike because of its silent operation Wheels and reel spiders are of the disk type Practically all parts, except the cutting knives, are zinc alloy die castings — light, tough, and practically unbreakable The wheels are equipped with oversize tires having a "full power" tread which is also a feature of the rubber tread on the roller

Metal Stretching Press

INSTALLATION of the first metal stretching press to be built and operated in the United States has recently been completed in the huge Middle River plant of The Glenn L Martin Company Built by the Engineering and Research Corporation from Martin specifications and first installed by the Martin Company, it is now being used daily

Primarily, the machine consists of two hydraulic cylinders placed beneath a platen between two rows of independent clamp jaws. The cylinders are attached to the platen in such a manner that they raise or lower the platen vertically The cylinders then operate in tandem, making it possible to obtain an angular position of the platen if desired.

In operating the press, a form is placed on the platen The sheet of metal to be stretched is placed over the form and clamped tightly in both rows of jaws Pressure is now applied on the hydraulic cylinders, causing the platen to move up—stretching the sheet tightly over the form

When the sheet has been sufficiently stretched so that it hugs the form tightly, the pressure is released and the formed piece also released from the block It is interesting to note that in the stretching process the thickness of the material is reduced only 5 to 7 percent

The stretching press is used principally for the forming of large sheets, such as skins, engine cowlings, and so on, which were formerly shaped on a power hammer It fills a definite need in the industry, principally through absorbing work which once required the use of hand tools, making it possible to turn out the work on a production basis.

The press does not in any way take the place of the drop hammer, but it appears probable that some parts that are now formed on the drop hammer may in the future be successfully manufactured on the new stretching press

Fountain Humidifier for Home

THE electric fountain humidifier is the newest development designed to aid in maintaining proper humidification of the air in the home This ornamental device,

shown in an accompanying illustration, operates from a 110 volt, 60 cycle, alternating current line, and needs no water connection Its sprays, which are pumped in a circuit, use approximately a pint of water per day. The device uses only 30 watts of electricity which is no more than a small electric light uses.

The humidifier is made of heavy spun aluminum and comes in five attractive colors- bronze, chromium, copper, red, and green Except for a soft splash of water,

Furniture is now being made from woven strands of synthetic plastic. Tenite, an acetate butyrate plastic developed by the Tennessee Eastman Corporation, is extrusion molded in continuous lengths and woven like reed or rattan for lawn settees, chairs, and tables. A crystal-like matting for wicker-type furniture is machine woven from narrow, transparent strands. Chairs of a more rustic type are hand woven from wide, flat strips of bright, translucent colors. Woven plastic seats have a slight springiness; the smooth surface cannot tear sheer frocks or stockings. Pieces of Tenite furniture, exposed to sun and rain for weeks and then immersed in hot water for 48 hours, showed no deterioration

the device is noiseless. It will not cause radio interference and the manufacturers claim that it cannot leak or get out of order.

DEADLY WIDOW

THE venom of the black widow spider is approximately 15 times more potent than that of the rattlesnake. Hence, the principal reason more deaths are not reported from black widow bites is that she is a timid creature and bites only when cornered.

Glass Marking Inks

GOLD Seal Laboratory Inks for labeling small glass surfaces such as microscope slides and small containers are a recent offering of the Clay Adams Company. These are ready to use with steel pen, brush, or rubber stamp, and write as finely as paper inks. They are non acid, non corrosive, non inflammable, and resistant to acid, alkali, usual laboratory solvents, and high temperatures. They are recommended as well for porcelain refractories and other ceramic materials. Colors are red, white, blue, and black.

Instrument for Giving Sex Hormone Pills

A NEW instrument for depositing "banks" of male sex hormone within the body, in a painless injection in the doctor's office without need for surgical operation, has been described by Drs. Samuel A. Vest and John E. Howard in the *Journal of the American Medical Association*.

"Hormone banks" are the latest method of supplying sex or other gland products to patients lacking a supply of their own. Young men cheated of manhood by a mistake of nature have been given virility by this method, and Addison's disease sufferers have been restored to healthy, normal lives by it.

Instead of injecting a fluid preparation of the hormone, solid pellets of the material have been buried beneath the skin by surgical operation. The pellets form "hormone banks" on which the body may draw as the material is needed. Several months' supply can be given at one time.

The new instrument now makes even the surgical operation unnecessary. In the doctor's office, a wheal is made in the patient's skin by a local anesthetic. The injector instrument, containing the desired supply of hormone pellets, is pushed painlessly through the skin. The pellets or pills are ejected from the instrument, which is then withdrawn.—*Science Service*.

Garand Rifle Modified

THE U. S. Army's new self-loading Garand rifle, now in quantity production, has had its muzzle end slightly modified and simplified, to support the bayonet more solidly. A number of minor adjustments have been found necessary in the quantity-manufactured rifles that were not apparent in the earlier rifles produced by slower, small-scale methods, but no major faults have been discovered.

Ordnance men hoot at rumors that the Garand can't "take it" under field condi-

tions. Before it ever was adopted to replace the time-tried Springfield '03 model, it was put through the most severe treatment that hard-boiled Army men could think of It was dropped off a cliff on rocks and hard ground It was thrown into water and left there for hours It was rolled around in sand, kicked around in deep dust, tramped into mud Picked up and given no more wiping than was possible with the soldier's bare hands, it functioned with as much snap and smoothness as if it had come fresh from the gun rack.

Another criticism was that it would be difficult to clean caked carbon off the front end of the rod that takes the push of powder gases near the muzzle and operates the self-loading mechanism This rod is released with no other tool than a small screwdriver, and the carbon scraped off with the same instrument

The sights of the Garand, both front and rear, are coarser than those used in scoring world beating records with the Springfield However, it is pointed out, these sights are designed primarily for battle purposes, at 500 600 yard ranges If fancy shooting is desired, special sights can be fitted on the target rifles *—Science Service*

Bouncing Magnifier

DESK or general utility magnifying glasses break, chip, and scratch so easily that it is strange no one has ever thought of mounting them in rubber. The Mark Specialty Company did just that and

Writes, magnifies bounces

in addition, mounted a rubber socket on one side of the rubber rim so that the magnifying glass may be slipped on the end of a pencil The resulting device is one that can be thrown around the desk with impunity and it will actually bounce rather than break These small magnifiers are triple powered and come in six colors

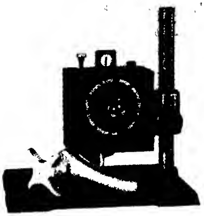
Dry-Ice "Keeps" Ice

KEEPING 350 pounds of glacial ice frozen on a trip halfway across the country is something of a trick, and scientists have accomplished it by packing the ice in solid carbon dioxide (dry-ice). The purpose of the unusual shipment was to study size of ice crystals at different depths in the glacier *—Solvent News*

Coating Thickness Tester

THE Aminco-Brenner Magne-Gage, an instrument for measuring local thickness of coatings on metals by the rapid, non-destructive magnetic method, has been improved since its introduction in 1937. The improvement, which greatly increases the utility of the instrument, now makes possible measurement of various types and thicknesses of coatings with only one instrument, simply by interchanging different types of magnets.

The instrument as now marketed will



Checking thickness of metal plate

measure nickel coatings on non-magnetic base metals, non-magnetic, metallic, or organic coatings on magnetic base metals, nickel coatings on iron or steel

The method is simple, rapid, non-destructive of the coating or the base metal, and is especially advantageous for both works-control and acceptance testing, since it permits testing of a large number of specimens at low cost

WAGES

THE motor transportation industry is responsible for one seventh of the nation's pay envelopes

Chemical Pioneer Prospectors

CHEMISTS have joined the search for oil and gas They are applying micro-chemical methods to the pioneer custom of finding oil deposits by surface seepages Unlike the pioneer prospectors, who located only shallow wells by surface seepages and sometimes not even those, modern chemical prospectors hope to develop a method of seepage analysis which will be an accurate guide to underlying oil deposits in any field and will locate wells at any depth

At present, they are concerned chiefly with the analysis of surface soils, or the gases contained in them, for minute amounts of various hydrocarbons and other compounds which indicate the presence of underlying petroleum deposits Soil samples from the surface or a few feet below are taken to the laboratory There, light hydrocarbon components are driven off by vacuum distillation Such heavy components as waxes are extracted in various ways and analyzed The presence of such divergent gases as hydrogen, ethane, ethylene, and propane is determined Liquid hydrocarbons from surface soils, and even hydrocarbon or partly-hydrocarbon soil waxes, are being used as possible indications of underlying oil deposits

Recently, a highly sensitive device known as the "mass-spectograph," used only in the physics research laboratory for "weighing" infinitesimal atoms, has been put to work. It is used as a modern divining rod, separating and identifying the minute amounts of surface gases which have escaped laboratory analysis.

With the "atom-weigher," it is possible to run a qualitative and quantitative analysis on an unknown mixture of hydrocarbon

gases smaller in volume than the head of a pin. Results of the analysis may be obtained in 10 minutes or less, scientists say.

Another device, newly-developed to aid discovery of new production horizons in already-developed fields, contains a very sensitive electric eye which responds to emissions of Gamma rays from geological structures. Lowered to the bottom of the well and raised slowly, the "eye" registers variations in the Gamma rays given off by each strata, which are recorded automatically at the surface.

Sun-Ray Filtering Paint

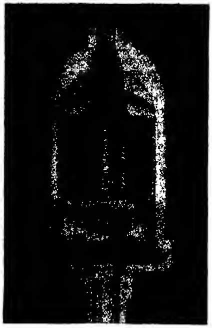
Eye strain resulting from sun glare is a great enemy of production efficiency. It contributes to poor work, less work, and unnecessary fatigue. A blue translucent material produced by the Skybryte Company is intended to eliminate sun-glare by spraying or brushing on factory windows. It is claimed that this material shuts out all glare yet admits 95 percent of the light, it filters out the heat producing rays of the sun so that there may be as much as a 15 percent decrease in temperature.

Preventing Water Hammer in Pipes

Many householders have found to their annoyance that a serious hammering occurs in the pipes every time a faucet is closed. This hammering sometimes causes breaks at pipe connections. Such breaks may not be important in homes but are very serious in industrial plants. The hammering is caused by the great increase in the pressure within pipes when the flow is suddenly stopped by closing the faucet. That pressure may run to as high as 600 pounds per square inch if, for example, the flow velocity is 10 feet per second.

Prevention of destructive water hammer may be accomplished by the use of relief valves and air chambers. Some householders simply mount a five or six-foot length of pipe vertically and close it at the

Cross-section of the bellows device that prevents water hammer



Back-pressure in water pipes is absorbed by compressible bellows

top to hold a column of air in the water main in the basement. However, there is difficulty in keeping the air in the chamber. Positive and permanent relief is obtained by the use of a simple device known as the Wacor Water Hammer Arrester. This consists of a closed metal bellows or compression compartment which is filled with a special compressible emulsion and is mounted in a casing connected to the piping system. With this there is no need for maintaining air in the chamber, for the back pressure is cushioned by the compressible bellows. The arresters are made in different sizes having bellows of different volumes.

When a Wacor Water Hammer Arrester is put on the line, the sealed compression chamber is partially compressed as the water pressure is turned into the system. When a valve or faucet is opened, the bellows expands, but when the valve or faucet is then closed the bellows acts as a spring to take up the shock by compression. The manufacturer claims these devices have been subjected to as many as a million shocks without rupture.

BEETLES

JAPANESE beetles this year will be attracted by traps painted yellow, as that color has been proved to attract more of these beetles than any other color.

Eating Glass

FOR generations laymen have believed that glass, if taken into the food tract in either powdered or chipped form, would be invariably fatal. This belief seems a little too broad in its scope, according to an article in the *Journal of the American Medical Association* which recently answered a query on this subject as follows:

"The ingestion of glass may or may not be fatal. The nature and extent of the harm done, if any, depends on the size, shape, and number of particles ingested

and on the presence or absence of food in the mouth with the glass or in the gastro-intestinal tract at the time the glass is swallowed. The danger lies in perforation of the wall of the stomach or the intestine and in acute or subacute gastro-enteritis It would hardly be safe to say that the average person can chew up and swallow glass without suffering immediate injury, but it seems to be beyond question that some persons can do so.

"Dr Walter S Haines ('Death from Pounded Glass and Other Mechanical Irritants, in Legal Medicine and Toxicology') reported a case in which 'a professional glass eater,' in the presence of Dr Haines and of Dr. E F. Ingals, ate half a dozen six inch test tubes, two good sized lamp chimneys, an ordinary four-ounce medicine bottle, two pieces of window glass, each four inches square, and three slips of colored glass each one inch wide and three inches long, biting the glass off the pieces offered him, chewing it up, and swallowing it much as if it had been an ordinary article of food The glass eater had eaten a hearty meal before submitting to the test, as was his custom before each exhibition He was kept under observation for several hours after eating the articles named, but at no time did he show any unfavorable symptoms. He died, however, two or three years later, from a subacute gastro-enteritis, presumably, Dr Haines says, from the irritation produced by his long continued glass eating There are other well authenticated reports of similar purport"

Cement-Lined Pipe

An improved process for the manufacture of cement lined steel pipe for transmission of highly corrosive fluids has been perfected by the Jones & Laughlin Steel Corporation The product is made on a new high speed mill especially designed for the purpose

In the J & L process, a special formula, not available on the open market, is used in lining the pipe. A measured quantity of

Longitudinal section of a joint of two pipes lined with special cement

the special mix is placed in the pipe and forced against the walls by a process which, combining centrifugal force with vibration, extracts a high percentage of the water This, cement experts agree, is desirable in attaining a lining with the highest physical properties. The process results in extremely even distribution of the mixture After curing, the pipe is given a final inspection and made ready for shipment

The combination of the special mixture and the process produces an even interior coating in the pipe, so smooth that the lining has a lower friction coefficient than the original pipe, yet so strong that no special

handling in the field is required to protect the lining, except that the pipe cannot be deformed. The pipe can be shipped, cut to length, and fitted just as unlined pipe—the lining being able to withstand without chipping any blow on the exterior of the pipe which does not actually dent the pipe

Cutting-Off Machine

A NEW machine of the bonded-abrasive wheel type is announced by the American Instrument Company, for cutting glass, quartz, ceramics, metals, commercial

and semi precious stones, and the like, in the form of sheets, rods, tubes, and blocks

Cuts up to 3½ inches can be made on materials with flat surfaces Rods, tubing, and the like up to six inches in diameter can be cut by rotating the material as it is being cut

True, clean cuts are made speedily and precisely by means of a motor driven 12 inch diameter rubber bonded abrasive wheel (0 04 or 0 06 inches thick)—without chipping or breaking the material

The machine is especially suitable for slicing all kinds of tubing, and makes extremely short cuts that are made only with great difficulty by other means For example, lengths of 1½-inch diameter glass tubing as short as 1/32 of an inch can be cut off as easily and quickly as longer lengths, and with smooth, parallel, unchipped edges

The machine consists essentially of a non corrosive cutting table, a cutting wheel direct-connected to a 115-volt, 60 cycle alternating current motor, and a centrifugal pump, mounted on a rigid steel stand

Operations to Correct Deformities of Infantile Paralysis Reported

OPERATIONS in which muscles are transplanted, bones reshaped, and joints fused together to help infantile paralysis patients recover from the deformities and handicaps left by the disease were reported by Dr. Henry C Hill, of Memphis, at a recent meeting of the Southern Medical Association.

One little girl whose case he described can now stand erect and walk fairly well since operations on both hips, both thighs, both knees, and both feet.

Operations should not be undertaken for at least two years after the attack of infantile paralysis, Dr Hill warned. If the cells of the spinal cord have been damaged but not killed by the infection, they will

eventually return to normal and resume their function of supplying the muscles with nerve stimuli or messages for action, and the paralysis will disappear, provided the patient has received proper treatment during these early stages This improvement may take two or more years, however Consequently, the surgeon should wait at least that long before operating to correct or minimize deformities

Muscle transplantation is suited to patients who have received proper treatment early in the disease By this operation, the strong group of muscles may be divided and enough of them transferred or transplanted to the opposite side of the joint to restore muscle balance, so the muscular pull is not all in one direction, which in itself may produce deformity — *Science Service.*

Laboratory Porcelain

A NEW chemical porcelain having remarkable properties is being used in the manufacture of laboratory sinks and other furniture This new product, Lappware, made by the Laboratory Furniture Company, Inc, is extremely dense, completely vitrified, non porous, and free from voids, blebs, and minute pore spaces It is exceptionally tough and difficult to break, its low thermal coefficient makes it highly resistant to thermal shock

The white glazed surface of Lappware will not discolor, craze, or oxidize, and it does not retain odors It is fired at a high temperature—2250 degrees, Fahrenheit—thus making it chemically inert to all acids, alkalies, and solvents except hydrofluoric acid, from which it is said to suffer less than a number of other commercial porcelains

Unique Foundry

THE success of Ford Motor Company metallurgists in developing cast-steel automobile and tractor parts as strong or stronger than the forgings they replace has led to the construction of a big new steel foundry unit in the Ford Rouge plant

Steel is poured continuously in the new unit, the molds being brought on a conveyor to the pouring spout of the electric holding furnace. Formerly it was necessary to pour intermittently because the steel was melted a few tons at a time in individual furnaces In addition to saving time, the new Ford method produces more uniform castings by delivering the metal for each casting at uniform heat and composition

The steel foundry is carefully synchronized It includes melting furnaces, steel holding furnace, core-molding machines, conveyors, heat-treat and annealing furnaces, and cleaning room Parts such as plow beams, tractor front axles, tractor radius rods, and wheel flanges can be made in sufficient quantity for 250 tractors a day. This involves pouring from 90 to 112 tons of metal a day. A smaller foundry unit constructed nearby will produce a variety of small steel parts in comparable volume.

Wood as a Paving Material

WOOD has long been employed in the construction of road surfaces, and under favorable conditions, a modern wood-block pavement is quite durable. It is, however, expensive to construct. In recognition

of the many desirable features of wood pavements and in an attempt to use large quantities of low grade and under-sized timber unsuitable for ordinary commercial purposes, the Deidesheimer method has been patented in most European countries, and is called "wood-stone" paving As the name implies, it consists of both wood and stone

On a previously prepared macadam base, either treated or untreated, the wood is placed in the form of cylindrical blocks, four to ten inches in height, which are cut from saplings or other undersized timber, preferably hardwood, with a diameter of from two to five inches The blocks are cut to the requisite length at the site, barked, and then impregnated, immediately prior to laying, in a vat of Wolman salts These treated cylinders are then placed on the prepared base in an upright position and tamped or rolled Stone chips are then used to fill the gaps between blocks, subsequent rolling and watering forcing the blocks into the base and the stone chips into the wood, keying the surface together This surface may be treated with an asphalt emulsion, which further fills the voids between the blocks, and a sprinkling of fine stone chips which are rolled into the exposed tops of the cylinders, forming a waterproof and durable surface The preparation of the base would be governed by the character of the traffic to be carried by the completed road — *N V Felsovanyi, in American Forests*

Who Was Shakespeare?

(Continued from page 264)

26th, *The San Francisco Argonaut* carried an editorial entitled "Who Was Shakespeare?", paying high tribute to the importance of the X ray and infra red evidence

Newspapers in France, Switzerland and Holland have also played up the story Charles Boissevain, a well known journalist of Geneva, is translating the complete Scientific American article into Dutch for publication in the Lowlands

Letters received by us from readers fell into three classes

Those whose writers objected to doubt being cast upon the identity of the "officially approved" Bard of Avon, those whose writers demanded more proof of Lord Oxford's identity before drawing any conclusions, and those — evidently already possessing some acquaintance with subsidiary evidence connecting Oxford with the Shakespearean authorship — whose writers greeted the publication of the X-ray and infra-red investigation as an event, charged with important historical and biographical implications We quote a paragraph from one of these latter, written by Fred H. Colvin, editorial veteran of the McGraw-Hill Publishing Company:

"The disclosures made by modern photographic methods show clearly that the old paintings had been altered. The resemblance of the faces and features, as shown, together with the careful study of the hands, ring and wild boar device, should convince the most skeptical. It has long been a

mystery to me why so many cling with a sort of blind loyalty to the idea that an illiterate butcher boy could have written of life and places of which he could have known nothing whatever"

One of the very last letters written and signed by the late Lord Tweedsmuir, the scholarly Governor General of Canada, expresses his thanks to a friend for sending him a copy of the January Scientific American. As a historian and writer of mystery stories, Lord Tweedsmuir (John Buchan) appreciated the evidence disclosed by the dissection of the Ashbourne painting

"I have read the article by Mr Barrell with very great interest Will you convey to him my thanks?

Yours ever,

TWEEDSMUIR"

For the benefit of readers of the January issue who demanded more evidence, we publish on page 264 an X-ray photograph of the Ashbourne portrait which was crowded out of the original article

This shows that underneath the rearranged hair which "Shakespeare" wears in his Ashbourne picture is the same type of large ear with the wide anterior opening that very peculiarly characterizes Lord Oxford in both of his inscribed portraits.

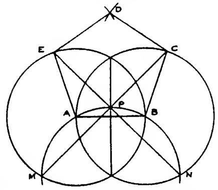
We would also reiterate that the evidence of the *three* disguised Shakespeare portraits which connects them with Oxford's personality in so many ways cannot be logically attributed to commercial art fakers who "accidentally" got hold of the portraits at various times and fixed them up to palm off on gullible Shakespearean enthusiasts

The disguises that have been applied to the original Oxford paintings bear so close a similarity, and are of such ancient application in the opinion of competent experts, that it is apparent that the work was done at a time when all three pictures were available to a small group, such as the original family owning them There is no record of any of these pictures, on the other hand, having been bandied around among unscrupulous art dealers Each of them has an "heirloom," rather than an auction room, background King William IV received one as a gift from a member of the Sidney-Herbert family of Penshurst Place This ancient Kentish manor was one of the homes of Lord Oxford's son-in-law, Philip Herbert Earl of Montgomery, to whom the First Folio of the plays of "Mr William Shakespeare" was dedicated in 1623

Problem: The Pentagon

FINAL problem of the series offered our readers by Lieutenant Commander Kaplan is as follows

The accompanying sketch shows a method of constructing a regular pentagon $ABCDE$ Two circles are described with A and B



as centers and AB as their common radius A third circle $MAPBN$, of the same radius, is passed through A and B Through P, the point of intersection of this circle with the common chord of the first two circles, lines are drawn from M and N which cut the original circles at E and C. With these latter points as centers, and the same radius as that of the three circles, arcs are swung which intersect at D, the final point of the construction Show whether the method is exact, and if not, determine the error of approximation by evaluating the angles at the five vertices of the pentagon

Solution of the Second Circular Pasture Problem

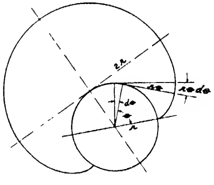
LAST month's problem read as follows

A circular fence encloses a field 200 feet in diameter. A cow is tied by a rope 200 feet long to a point on the fence, and outside the enclosure. Over what area will the cow be able to graze?

In a private communication to the Editor, Commander Kaplan had said "In spite of the brevity of the solution, this is not an easy problem The integration is rather differently accomplished than ordinarily The usual method of approach would lead to a much longer solution" "*Why* didn't the Editor tell us this fact *last* month, when it would have done some real good?", many a reader is going to say to this Well, isn't mathematics like that? Did the professors ever give the poor victims advance tips in examinations? Ours didn't This is a cruel world, without a doubt

The solution

The cow will be able to graze over a semi circle of radius $2r$, and the two equal areas which lie between the circular field and the curve traced out by the free end



of the rope as it winds around the fence The element of area for the latter may be taken as the triangle shown in the accompanying sketch, and the area of each loop will be expressed by the integral,

$$\frac{r^2}{2}\int_0^{\pi} \theta^2\, d\theta = \frac{4}{3}r$$

The entire area encompassed is therefore

$$2\pi r^2 + \frac{8}{3}r^2$$

and, since r in the problem given is 100 feet, this evaluates to

$$20{,}000\left(\pi + \frac{4}{3}\right) = 89{,}498.52 \text{ sq. ft.}$$

YOUR FIREARMS

Conducted by A. D. RATHBONE, IV

INTEREST IN FIREARMS is *traditional with American men, science has so developed them that millions yearly find sport and recreation in their use. Hence this monthly department presenting a wide variety of discussion regarding firearms, their handling, and their accessories. Suggestions from readers will be heartily welcomed.*—The Editor

THE TEST OF TIME

WHEN Theodore Roosevelt said, "The old days were great because the men who lived in them had mighty qualities," he could have added that the doughty individuals referred to injected into many of their actions and some of the products of their hands a goodly portion of those same "mighty qualities." Take firearms, for example. Samuel Colt introduced his famous Single Action 6-shooter, 45 caliber "Peacemaker" in 1872, and followed with the equally well known and similar "Frontier" model in 44 and .44-40 calibers, a gun which has changed but little during the past 68 years. John M. Marlin perfected his repeating, lever-action rifle in 1880 and 10 years later applied the principle to a solid top, side ejection 22 caliber rim fire rifle, known then as Model 1891 and today as Model 39 A. These are but two instances of those "mighty qualities" of which "Teddy" Roosevelt spoke, instances in which men of earlier days so nearly attained perfection in gun craftsmanship that artisans who followed their footsteps have been unable to improve the basic features of these two firearms.

Although refined by later day experts and engineers, the Colt Single Action Army Revolver of today is still fitted with the original "Peacemaker" type of hammer, trigger, action, and rod ejection mechanism initiated by Samuel Colt 68 years ago. As of old, the gun is available with barrels of 4¾, 5½, and 7½ inches, and the weight has varied little. The splendidly told, profusely illustrated story of Colt arms, "A Century of Achievement," depicts both guns, and, as may be seen from the pictures in that book, the similarity of lines and details is striking. Save for the grip and the front sight, the 1873 "Peacemaker" and its 1940 counterpart are practically twins.

Easy to clean

John Marlin made gun history and created a sensation when he brought out his 22 caliber, lever-action repeater in 1891. Not the least among the original features still found in the same gun, 49 years later, are the deep-cut Ballard rifling, noted for accuracy, and the ease with which all working parts may be exposed for cleaning and oiling by the turning of a single screw. This was accomplished by making the cover plate a part of the stock, thus separating the receiver into two halves. That portion of the receiver to which the barrel is attached carries the breech bolt and the ejector. The other half of the receiver, to which the stock is fastened, houses the finger lever, hammer, trigger, cartridge carrier, and other working parts, all of which are securely attached and impossible to lose when the rifle is apart or in take down condition. In addition, the 39 A remains, as at the time of its inception, the only lever action, 22 repeater manufactured.

We've no intention of belittling the exploits of pioneers in other fields, but it does seem worthy of note that in few products have there been less basic changes during

Retaining the best features

the past half century. With everything being "streamlined" and brought "up to the minute" these days, it's gratifying to know that in the realms of handguns and rifles at least certain basic principles have so successfully withstood the multiple tests of time, world wide distribution, and varied usage that it has been difficult to improve on them. Continued universal acceptance of the underlying methods of operation of Samuel Colt's "Peacemaker" and John Marlin's lever-action is a tribute, indeed, to

Marlin's Model 1891, after 49 years, becomes Model 39-A, above

those who today direct the policies of their respective houses by carrying on the sound tenets of firearms manufacture originated many decades ago by Messrs. Colt and Marlin.

Mossberg's Triplets

IT has long been more or less an axiom in firearms circles that when O. F. Mossberg & Sons, Inc., announces some thing new in rifles, the .22 caliber section of the gun world sits up to take prompt notice. The heralding of the three latest Mossbergs, Models 42M, 46M and 51M, has proved no exception to this rule. In the order named they are a 7-shot clip repeater, a 22-shot tubular repeater, and a 15 shot automatic, all .22 caliber, all Manlicher, Mauser, or Military type — which ever name you prefer — and all rugged and built for dependability and accuracy. Each member of this new family of "M's" is equipped with hooded ramp front sight with four permanently attached inserts, No 2A rear sight with screw adjustment for windage and elevation, No 4 microclick peep sight which swings out of the way, permitting use of open or 'scope sights. They all have detachable swivels, non breakable molded trigger guard with finger grooves, and in the cases of Models 42M and 46M, a Mauser-type bolt which hugs the stock and doesn't interfere with 'scope mountings.

If you've ever had a "flash-back" occur while shooting, you'll appreciate Mossberg's new cover plate, which is attached to the bolt and moves over the ejection port hole when the bolt is closed, to provide additional safety for the shooter and to help keep dirt and other foreign matter out of the loading port. If you like a clip-type rifle, you'll find the 42M exceedingly practical, for the butt-plate has a "trap door" and the stock is cut out to permit insertion of an extra clip of 7 shells. If you

No flashbacks with the new Mossberg bolt-action .22 rifle. A plate covers ejection port when bolt closes

Right: In the same gun as shown above, an extra clip is carried in the stock

dislike loading, you'll like the capacity of the Model 46M.

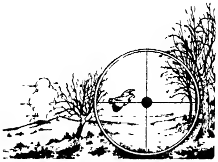
On the other hand, if you're of the automatic school of firing, the 51M fills the bill and handles .22 regular or high-speed long rifle cartridges, either lubricated or dry, without any change, and you can pack 15 of them into the magazine.

The Mossbergs prefer that the shooters of America christen this new family of "M" models, so this is a case of "Name it and you can have it." There'll be a check for $100 and choice of any of the 3 models as first prize in this name contest. Second and third prizes are $50 and $25 respectively and, again, the winners have a choice of the new guns in addition to the cash awards. We've a good supply of Mossberg catalogs and entry blanks for this contest, so let us know if you want them. There's no catch to this, nothing to buy. Be kind of nice to have a new gun this season, wouldn't it?

From the Mail Box

FOLLOWING publication of the story, "Shotgun Heresy" in the January issue, we received a number of reader inquiries requesting more information on the one-power (no magnification) shotgun 'scope, made by the W R Weaver Company, for use in trap, skeet, and wing shooting. Now comes a note from "Bill" Weaver enclosing copy of a letter from T. K Lee, Birmingham, Alabama, who reports complete satisfaction on a South Carolina quail hunt with the Weaver 1-X 'scope on a 12 gage Winchester pump scattergun, and who writes "I don't recall missing a shot that was in the open or where the bird was in sight."

The Weaver shotgun 'scope and . . .



how you sight with it

Claiming equal success in dove and crow shooting, Lee also spoke of breaking 49 birds in skeet, "heavily dusting the lost bird," while at the 16-yard traps he won a turkey shoot with another 49. But the extreme versatility of this Weaver 'scope, and, incidentally, of Lee's marksmanship, too, is shown in the following quotation from Lee's letter: "Past Saturday we varied our rifle program a little and did a good deal of shooting at aerial stuff with the .22 and this 'scope. For lack of something better, we used black walnuts, which measure 1 to 1⅛ inches when hulled and are a pretty stiff target for this stuff, when pitched about 20 feet high. I had one run of 24 straight, taking all shots, whether good tosses or not. I find it very definitely easier than with peep sights or open sights and no trouble to put in repeat shots. Mine is mounted on a Remington pump 22, but if I had it on an automatic, I could put in three to four shots easily."

All of which bears out Weaver's own claim that "the 1-X 'scope is unbeatable for many kinds of rifle hunting, especially large game and moving game, for fast shots and in wooded country. For rifle," Bill

continues, "a flat top aiming post is used instead of the large, coarse center dot designed for shotguns." We have on hand a supply of Weaver's folders, describing and picturing his 'scope, and you're more than welcome to one, if you'll just drop us a line.

PITTMAN-ROBERTSON ACT

OF importance to all who buy guns and ammunition was the recent address by Albert M. Day, Chief of the Division of Federal Aid in Wildlife Restoration, Bureau of Biological Survey, to the North American Wildlife Conference in Washington From the 10 percent excise tax on sporting arms and ammunition, Federal appropriations have been made to states which have given specific legislative assent to Pittman-Robertson Act provisions, the Federal Government bearing 75 percent and the respective states 25 percent of the cost of these undertakings Some fine work has been accomplished, such as taking submarginal lands out of agricultural production in 15 states to provide badly needed range for deer, elk, moose, and bighorns, and food, cover and sanctuary for grouse, turkeys, pheasants, quail, Hungarian partridge, ruffed grouse, sharptails, rabbits, and other species of birds and animals Projects for purchase of areas to restore conditions for waterfowl and fur bearers are being considered in six other states Re vegetation of lakes and water courses, re-seeding of burnt-over areas, re allocation of game populations, and research laboratory work are among other activities, all tending to improve the nation's wildlife resources Summing up, Day said "If the game departments confine their activities to those of the caliber undertaken during these early stages, Pittman-Robertson will, in truth, become, as its sponsors predicted, the greatest boon to wildlife conservation since the passage of the Migratory Bird Treaty Act in 1918."

Pot-Shots

AT THINGS NEW

THE AMERICAN INSURANCE GROUP now issues an "All Risk" insurance policy on guns, cases, ammunition, extra sights, and other shooting equipment at a rate of 1 percent on the amount of insurance, subject to a minimum annual premium of $5 Protection is afforded at home, in the field, wherever the insured property may be.

SMITH & WESSON presents to the handgun fraternity their new S & W "K-22 Masterpiece" as a worthy successor to the famous S & W. "K-22 Target Revolver" Incorporating a 6-inch, precision drilled, reamed and rifled barrel on the frame of the veteran 38 M. & P. target gun, with an over-all length of 11-1/8 inches and a weight of 35 ounces, the Smith & Wesson folks have produced a .22 caliber handgun which embodies even greater speed, accuracy, and ease of handling than the world-known "K-22." The cylinder, with recessed head space, is chambered for the .22 L.R. cartridge, as well as any other rim fire .22. New developments which command attention are the S. & W. micrometer rear sight, which provides positive two-point click adjustments for windage and elevation—and these adjustments will not shoot loose, the "Speed Lock" hammer, which offers shorter, faster, easier cocking, and allows grip to remain unchanged during fast fire All in-all, this "K 22 Masterpiece" is a "he-man's" gun, made "with the rugged precision of a French 75," to quote Cy Bassett, of S. & W. Want a folder? We have some.

AMERICAN OPTICAL COMPANY has developed a synthetic sponge sweatband for elimination of the hot-weather perspiration problem, faced by all target-shooting devotees It is adjustable to any head size by an elastic band, may be worn with or without a hat; is washable

HARRINGTON & RICHARDSON ARMS CO has introduced a new six shot target revolver, known as "Eureka" model It weighs 30 ounces, has six-inch barrel with sights adjustable through large-headed screws, and choice of 11 different sizes and styles of grips, with standard equipment No 4 thumb rest type Gun has leaning rear sight to remove possibility of shadow To preserve the set pull in pounds and to offer smoother, sharper action, trigger pull is adjusted by means of rounded edges, rather than sharp edge hammer notch Cylinder latch is on left side for easier handling, thimble and extractor are heavier, lifting ratchet has two points, all tending to increase wearing qualities

WE'VE A HUNCH that most gun owners are also the possessors of fishing rods of one kind or another, so we just have to mention three splendid angling publications which, to us, are The Books of the Moment. They are, "No Life So Happy," by Edwin Lewis Peterson, "Fur, Feathers, and Steel," by Reuben R Cross; "The Fly Tyer's Handbook," by H G Tapply. If you fish, you'll like 'em all, if you tie your own lures, the latter two should be on your "must" list.

GLAD RAG PRODUCTS CORP offers a polishing cloth, approved by Good Housekeeping Institute, which is sufficient unto itself without paste, powder, or polish In either 10 or 20 cent size "Glad Rag" performs brightening miracles on all metal sporting equipment with a minimum of "elbow grease" — works equally well on silver, too, so if you don't find it in your sports cabinet, look in the kitchen.

NEW METHOD MFG. CO. has a product, "New Method Gun Bluer," which immunizes guns against exterior rust, corrosion, and dampness, is easily applied with a camel's hair brush, and restores highly polished blue finish "New Method" is not a "chemical" cleaner, but is a hard, perfectly colored lacquer.

ATTENTION, you gun collectors and gun clubs of the Louisville and Lexington, Ky., area! Take a few minutes from your first-of-the-season trout fishing and visit the collection of antique guns and arms being shown during May at Stewart's Dry Goods, Inc., Louisville, Ky. The firearms in the exhibit are supplied by International Studio Art Corporation, were formerly part of the William Randolph Hearst collection.

Conducted by JACOB DESCHIN, A.R.P.S.

Dogs

DOGS are wonderful playmates but exasperating camera subjects. Particularly is this true of the younger set, who appear to be on the go every minute of their lives. Dogs are best photographed when they show the appearance of being on the alert. On the surface this would seem to be easy to do but in practice it will be found one of the most difficult of all photographic "assignments." The dilemma facing the photographer of dogs is that, although most characteristically pictured when 'busy,' the dogs will generally be sufficiently quiet for leisurely photographic work only when at rest.

Needless to say, photographing dogs calls for an alertness on the part of the camera worker perhaps greater than that of the subject itself. At the same time that he attempts to keep the dog interested in one thing or another, the photographer must also think of the picture. This means that he must watch patiently for a good pose and be quick enough to capture it with his camera. As the dog moves about, ready to dart this way or that at a moment's notice, the photographer must follow the dog's lead and move the camera viewpoint in unison with the unpredictable movements of the dog.


"Patsy"


"Lookout"


"Siesta"

However, in spite of the obstacles, many good dog pictures are made and some of the best are the work of amateurs. It is chiefly a matter of watchful waiting for a good pose plus ample lighting conditions, agreeable background, and full exposure.

As for lighting undoubtedly the outdoors on a bright day is the ideal because there is so much light about that the dog can move in perfect freedom (as it will anyway) and still be suitably lighted in one pose or another. Indoors, the dog's movements are greatly restricted, photographically speaking, because only a small area is lighted and unless the dog remains within that area, it will not be illuminated and therefore cannot be photographed. However, there is a logical solution to this problem in the use of the synchronized flash. Since the lighting source, attached to the camera, moves with the camera, and is "flashed" in the same instant as the shutter is opened, the subject is bound to be lighted during the only period you care about the moment of exposure.

Ample lighting is important in dog as well as general animal photography,

because one of the most valuable features of dog pictures is the manner in which the texture of the subject shows up. For this reason, also, full exposure is necessary in order to take advantage of all the available lighting. At the same time, the worker must be sure to use a shutter speed brief enough to stop the movement of the dog so that the subject is sharp on the resulting negative. It is true that a little off-sharpness in the legs as the dog jumps into the air, for example, may add to the impression of movement, but it is best not to take too many chances with this, a complete blur may be the result.

Perhaps it is safe to say that pictures of dogs in movement should not be taken at shutter speeds slower than 1/100th of a second. Many inexpensive cameras are equipped with shutters having this as top speed. Those which do not would best be restricted to dog poses which show only moderate movement, or those instances when they are well pictured in quiet, restful attitudes.

When you photograph a dog or any other subject you must not forget that you also include the background in your picture. A poor background — one, for example, in which there is such distracting material as telephone poles, picket fences, and so on — may spoil an otherwise fine picture. Therefore, select a suitable background and try to induce the dog to move in that area. The greater this area, the simpler your problem. If the area must be restricted, for one reason or another, your work becomes more difficult.

In this connection, we cite an experience in photographing an Irish setter against a background of trees. Particularly were we interested in two of the trees, one to the left of the foreground, the other, curve shaped, farther back. We wanted to get the dog to pose between these two. We were not quite sure just what pose we wanted, and did not bother too much about this because we felt that any agreeable pose would be suitable provided the dog stopped somewhere between the two trees and near the large straight one in the foreground. Luckily there was a bench nearby where we could sit and patiently wait for the picture. We threw an apple where we thought it would do the most good but Patsy simply snatched it up and ran off quick as a flash. We tried it again and again with somewhat the same result. Every once in a while Patsy would stop to

By Edward A. Schultz, from the Fourth International Leica Exhibit

"Silhouette"

rest but too far off for our purposes. Finally, she stopped for an instant in the foreground, attracted by something off to the left and as she did so we snapped quickly and so obtained the only usable negative. The procedure took about an hour but the result is one of our favorites. Patsy, an ardent lover of the woodlands, pictured in an atmosphere most congenial to her nature.

Automatic Control in the Darkroom

A DEVICE that takes one more worry off the shoulders of the darkroom worker and assists in doing better work with the enlarger is the new Bee Bee Dual Control Auto Timer just introduced. The two

circuits of this device make it possible to turn off the safelight while switching on the printing light or to reverse this procedure at the termination of focusing or exposure time. When the darkroom worker touches a toggle switch, the exposure is started and is terminated automatically at exactly the time selected. Further, once the mechanism is set, it is possible to repeat exposures of exact duration, the mechanism resets itself without further attention.

Operation of the Dual Timer is accomplished by the use of a self-starting synchronous motor. The whole device weighs only five pounds and measures $4\frac{1}{4}$ by $4\frac{1}{2}$ by $5\frac{1}{2}$ inches.

"Photospot News"

A MONTHLY bulletin addressed to camera clubs has been inaugurated by Raygram Corporation, New York City, for the purpose of acquainting club members with "the latest in photographic news,

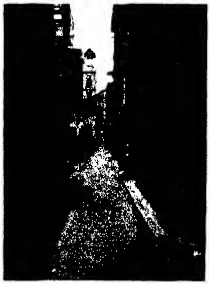
views and previews" It will be edited by Albert Greenfield, photographer, traveler, and a well known figure in photographic circles Primarily designed as a news bulletin, it will contain description and illustrations of new photographic equipment as well as other news and notes of interest to amateur and advanced photographers Camera clubs interested in receiving this bulletin should write to Photospot News, 425 Fourth Avenue, New York, N Y

Shooting Alleys

An alley is a short, very narrow street or passageway People actually live in alleys Remember Henry Carey's Sally·

"Of all the girls that are so smart
There's none like pretty Sally;
She is the darling of my heart,
And she lives in our alley"

Clarence Tolle, of Cincinnati, Ohio, does not live in an alley but alleys seem to fascinate him His town is full of them, and



"City Alleyway"

he likes nothing better when out with his camera than to make a round of the alleys and take pictures of them under various lighting conditions As a result, he has a considerable collection of alley pictures taken in his city, one of these is reproduced here He doesn't care what other people may think, but an alley to him is No 1 on the list of picture possibilities in his town.

Best School Picture

The accompanying reproduction, "A Very Good Boy," photographed by Ambrose J. Hickey, staff photographer of New York City's Board of Education, was chosen in a poll of New York City's 37,000 school teachers The vote was taken to select the best pictures that have appeared in Superintendent of Schools Harold G Campbell's annual report called, "All the Children." It received a total vote of 5062, two and a half times as many as that received by its nearest competitor Second place was given to a picture entitled "The Youngest Artist," which showed a kindergarten boy at work before an easel; third place to "Boy Building Blocks"; and fourth place to a picture entitled, "Charge d'Affaires Bag," which showed a little boy trudging to school with a brief case almost half as

"A Very Good Boy"

big as he is, but containing only one book Dr Campbell, in commenting on the first choice of the teachers, said that its popularity was due to its human appeal and to the fact that it was typical "It might have been taken at almost any school, anywhere in the country, at any time," he said

Development by Inspection

THE often desirable method of developing films by inspection may be practiced with the slower brands of film by comparing the developing film with a standard negative However, unless this guide negative is unfixed, it will not do for this purpose The unfixed-out salts must remain in the guide negative in order that it may match the developing film which, even with development complete, looks denser than the final, fixed negative will be To obtain the arrested development which normally is done by fixing in a hypo bath, the comparison negative, according to a tip in the *Gevaert Sensitizer*, is developed, washed for a short time, and then bathed for a short while in a 2 percent potassium iodide solution

Acid-Resisting Enamel

FOR the chap who is making his own wooden darkroom sink or table, we have recently come across a preparation that seems to serve the purpose with full protection against damage The material is known as Tuf-On No 274 Enamel and is especially adapted for use on articles connected with photographic work and developing We asked the manufacturers for details and this is their report:

"This is an acid-resisting coating made from Bakelite resin, which will protect all darkroom equipment from hypo, developers, acids, and so on, and when used on trays or racks will keep solutions free from contamination It can be applied to wood or metal solution tanks, reels, table tops, and so forth

"The material is applied by brush just as it comes from the can, and will set in about 15 minutes and dry in one hour However, at least eight hours should be allowed before strong solutions come in contact with it. One coat is usually sufficient to cover any surface, but if a second

coat is necessary, it would be best to allow eight hours for drying before the second coat is applied

"The only precaution necessary in applying the material is that the surface be smooth and dry and free from dirt, wax or oil, so that the enamel has a good opportunity to make a strong bond with the surface If a surface is oily or has been waxed, then it should be cleaned by wiping with plenty of turpentine, wiping off the excess with a dry cloth Rough or rusted surfaces should be smoothed with sand paper before an application is made This material comes in aluminum, black, gray or clear"

Temporary Lens Board

OCCASIONALLY you may wish to try out a friend's lens on your camera or to experiment with a lens before deciding to make the actual purchase This is provided, of course, that your camera permits of interchanging lens boards To go to the expense of making a special lens board is out of the question An effective temporary lens board may be made of a thick piece of cardboard cut to the required dimensions In the center of the board a hole is cut the diameter of which is slightly smaller than that of the lens barrel Now "screw" the lens barrel threads into the cardboard hole The barrel threads will cut threads into the cardboard and so hold the lens firmly in place while you put it through its paces

History in Photographs

THE formation of a Contemporary History Division "to collect and disseminate photographic information that will be of aid to historians," is announced by the Photographic Society of America The plan is to work through existing agencies and coordinate the activities of those now engaged in this field rather than to set up a separate organization The committee's first chairman is Dr A J Olmsted, Chief Photographer and Custodian of the Section of Photography of the Smithsonian Institution and the U S National Museum of Washington, D C

One of the most interesting sections of the Division will be that devoted to stereoscopic slides and cameras, this phase to be under the direction of Robert Dennis, of Brooklyn, New York, reputed to be the owner of the world's largest collection of slides, a total of more than 100,000, and old stereoscopes

The Photographic Society of America has also instituted an interchange of stereoscopic slides for individuals. "Each participant," acording to the announcement, "will add a slide to the group that is sent for his inspection before sending it on to the next individual When the collection returns to him at the end of a couple of months, he will remove his old slide and substitute a new one There is evidence that there are more users of stereoscopic devices in this country than anyone would believe and the Society feels that such a service would fill a definite need"

Another plan being worked out by the Society is for the interchange of Kodachrome slides The plan is to have two sections, one for clubs and one for individuals. The first will work along the same lines as the present Club Print Interchange

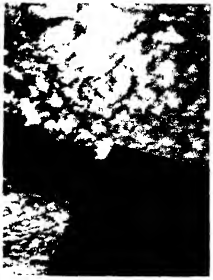
and Loan Exhibit Service of the Society, that is, Kodachrome sets of approximately 50 slides will be collected from a single source and made available for club showing

The individual section will consist of the work of the participants Each member will add one of his own slides to the set he receives before passing it on to the next individual He will contribute one slide per month to provide 12 different groups circulating among units of 52 members

Anyone wishing to participate in such a service should communicate with the Secretary of the Photographic Society of America 10 Park Avenue, New York, New York

Clouds Save The Day

THE presence of clouds is always a good excuse for a picture, and subjects which ordinarily hold no promise can frequently be worked in very nicely when shot against



"The Barn"

the background of an attractive cloud effect A barn of itself may or may not offer a picture possibility, but in combination with clouds against a dark field of sky obtained with an orange filter, it may well justify a shot, as in the present case Angle composition seemed to tie the picture into one piece

Leica Manual 1940-41

COMPLETELY revised to include the latest information on miniature camera photography, a new printing of the "Leica Manual," designated as the 1940-41 edition, has just been issued A new filter factor table is included, film groupings have been changed to coincide with recent advances in films for miniature cameras, and new information is included on developers, exposure, projection, stereo projection, lenses, Leica accessories, and so on.

Don't Argue With The Instruction Book

"AFTER all," says the concluding sentence in the foreword to an instruction booklet for one of the Filmo cameras, "we made the camera, so first try our way of using it" There's a lot of common sense back of that, obvious though it may appear to be. Over-confidence and eagerness to get going with the new outfit frequently induces people of newly purchased cameras to use the camera before they have read the instructions The consequence too often is that something jams because some little gadget was not properly adjusted, although reference to a single line in the instructions would have avoided the accident

"We have had a good many comments on that sentence, all of them favorable," say Bell & Howell, the makers of the Filmo cameras. "Before the book went to press, we tried out the statement on several disinterested individuals, and as the reaction was 100 percent favorable, we dared to include it One new owner in New York City visited our office just to meet the boys and to congratulate us on having the temerity mildly to twit the owner"

Personally, we believe that one of the principal reasons people do not read instruction books as thoroughly as they should is because they are not always as clear in their explanations as they should be Also the size and appearance of the type and general layout is not attractive enough Our advice, if anyone wants it, is this make the instruction book as good-looking as your advertising literature, and it will be read

WHAT'S NEW
In Photographic Equipment

If you are interested in any of the items described below, and cannot find them in our advertising columns or at your photographic dealer, we shall be glad to tell you where you can get them Please send a stamped envelope with your request

Kodak Advance Enlarger (complete with 98mm, $f/11$ lens, \$27 50) Specifications Takes all popular amateur sizes, including 3¼ by 5½ inches (from which 3¼ by 4¼ inch area may be projected), lens interchangeable with any lens mounted for use in Kodak Precision Enlarger, magnification up to 5½ diameters on baseboard with standard lens, up to 13 diameters with 2 inch lens (for greater enlargements head and bracket may be swung to project on floor), baseboard 17½ by 22 inches, natural finish 5 ply maple, pre-sealed under pressure to prevent warping (same base as supplied for Kodak Precision Enlarger), column rigid nickel-plated brass tube, 1-1/16 by 24 inches, vertical, set in die cast aluminum base bracket, support bracket of die-cast aluminum with knurled screw, enlarger head attached with two knurled and slotted screws and removable at will, to use column as copying stand, lamp-house of sheet metal, aluminum finish, parabolic interior curve optically designed to insure even reflection of light to negative opal diffusing screen approximately ½ inch above negative, lamp 75-watt opal No 211 Mazda Photo Enlarger Lamp

Albert Four-Way Safelight (complete with filters and stand, \$3 95) Through simple adjustment, choice of four basic filters provided· diffused white light for viewing, red for orthochromatic film, green for panchromatic; green-orange for enlarging and contact paper Lamp adjustable to provide reflected or partially reflected light for handling ultra-fast film. Four filters built into oblong box with one filter on each side. Box itself slides into lamp

To change filters, operator draws out filter box, rotates it to proper color and returns it to light. Adjustable ball and socket joint for directing light at any angle.

EFFECTIVE LENS APERTURE KODAGUIDE (10 cents). For use in copying and small-object photography, when lenses are used at other than normal extensions. Covers all lenses from 25mm to 30 inches focal length, and lens-to-film distances from 1 to 64 inches One dial setting, for a known lens-to-film extension, indicates effective values of f/ numbers at that degree of extension, and also gives correct factor for increasing or decreasing shutter time at indicated f/ number setting, to obtain normal exposure

TROJAN EASEL ($6 65) · Will take up to 11- by 14-inch paper, providing borders ranging from ⅛ of an inch to 1½ inches. Channel grip simplifies inserting paper accurately Paper firmly held in place by clock spring masking bands which lie flat and prevent fogging at edges Borders easily adjusted to paper sizes by exclusive spring mechanism which eliminates need for tightening screws. Easily visible, large white numbers

BELL & HOWELL DE LUXE MODEL HOME FILMOSOUND ($343) Complete in polished walnut cases Projects either sound or silent 16mm movie film Illumination by 750-watt lamp Complete information available on request

KODAK PROJECTION PRINT SCALE ($1). Testing device for determining exposure time and choosing correct contrast grade of enlarging paper Scale is four-inch disk divided into 10 numbered sections which decrease clockwise in density Test print is given 60-second exposure, with scale placed on top of sensitized paper in paper holder After print is developed, correct exposure time, in seconds, can be read directly from best sector, as printed

COMMANDER ELECTRIC EXPOSURE METER ($20) Employs photometric principle. May be used under wide variety of light conditions Does not require approaching the subject but is employed from the position of the camera. Also adaptable for use as an enlarging exposure meter "Miracle Eye" feature gives average reading of entire scene, whether near or far from camera. Maker's claim is that the "Miracle Eye" makes is possible to measure light on any detail of a scene, to obtain reading on object unfalsified by stray light, background, and reflections, to measure an area of light as small and as dim as flame of a candle 100 feet away.

KEMP WHIRLPOOL ACTION PRINT WASHER ($1 50) · New in design and principle Adjusts and converts any sink or basin into efficient print or negative washing tank. Hypo-laden water, drawn off the bottom, is constantly replaced with clear water flowing at any rate of faucet flow.

LAFAYETTE DURALUMIN COMBINATION TABLE-TOP TRIPOD · For use with miniature cameras of all types. Weighs only 8 ounces complete, but said to be capable of providing support for weight of about 100 pounds. Three rubber tipped duralumin legs screw into supporting collar, which contains "extension neck" permitting adjustment of camera on tripod from heights of 11 inches to 17 inches Neck completely removable from supporting collar May also be used as handy neckpod by employing full leather strap attached to bottom of extension neck.

UTILITY CUTTER (Handle and one blade, $1.00; extra blades, 60 cents per dozen) · Adjustable device for holding cutter blades in proper position. Metal frame fits hand, uses heavy-weight blades that slide into handle when not being used. Cuts cardboard of various weights, heavy wallboard, or light veneer wood Polished aluminum handle with wing locknut

CHARDELLE FLASH CALCULATOR (50 cents) Rotating device fitting pocket for determining shutter speed and f/ stop for various flash bulb sizes at different distances Disk carrying row of shutter speeds and row of distances, the former ranging from "open" and 1 50 to 1/1250 of a second, and the latter from 6 feet to 68 feet, is lined up against a row of Weston film speeds ranging from 4 to 100. As disk is turned, the desired distance is set against the speed of the film being used The f/ stops are on a separate disk, which is turned until one of four different light conditions (outdoors night, interiors very dark, interiors average, and outdoors daylight) stands opposite a number designating the bulb being used A table on the back of the calculator, which is laminated, provides a list of Weston speeds for the most popular films and a list of Chardelle illumination factors, or numbers, for the most frequently used flash bulbs

HAYNES "SALON" ENLARGING PAPERS Coated with a bromide emulsion which, the maker states, is literally loaded with extra silver The result is to produce blacker blacks and to bring out deep shadow details that are often lost with other papers The paper base itself is of pure rag stock of great strength "Salon" paper does not require special handling Dries to slightly greater contrast than when wet. Supplied in three different grades

MIGHTY MIDGET ADAPTER ($1 25) Equipped with built-in ejector for use with Mazda No. 5 Photoflash bulb Centers bulb in reflector Ejector discharges bulb instantly when slight pressure is applied Ejector has standard screw type electric bulb base and may be used with all synchronizers now on market

WABASH SUPERFLOOD REFLECTOR LAMP ($1 10). Inside-silvered, self-reflecting, outside-frosted Average burning life six hours at 115 volts. Lamp and reflector a single unit Silver lining sealed inside bulb provides brilliant reflecting surface. Oversize bulb gives oversize reflecting surface. Special silver lined neck disk redirects what would otherwise be neck-wasted light. Scientifically correct coordination of bulb, filament, and reflector.

TIMIT ($12.50) · Combination enlarging exposure meter and automatic exposure switch. Employs test strip principle but by automatic operation. Also automatic time switch for exposing enlargements.

CAMERA ANGLES ROUND TABLE

JACOB DESCHIN, *conductor of our "Camera Angles" department, will answer in these columns questions of general interest to amateur photographers. If an answer is desired by mail, enclose a stamped, addressed envelope. Queries should be specific, but Mr Deschin cannot undertake to draw comparisons between manufactured products nor to advise on the purchase of equipment or materials*—The Editor.

Q. **I am an amateur portrait photographer, but recently a friend, who owns a beauty salon, asked me to take some pictures of her hair styles for a display. Can you give me details as to lighting, camera angle, and filter? I have a good miniature view camera, tripod, and four No. 2 Photoflood lights with diffusion screens.—F. G.**

A Your objective is, first, to light the hair in such a way that the details of the hair dress will show up clearly, and, secondly, to adopt that angle that will present the subject to best advantage and give as complete a picture of it as you can in a single shot. Therefore, you should use one front light tilted down towards the head a little, depending on the pose, and another light from the side and slightly back of the subject; this second light should be at an angle of about 45 degrees to the head. The best effect is achieved with spotlights. A compromise can be effected with your lights by using cardboard with a hole cut in the center. Your lighting should be well balanced because it is the complete head dress that interests you and not just a detail of it. Make sure that no dark "pockets" are left where light has failed to reach the hair. This can be done either by manipulating the lights or altering the pose. The camera angle will naturally be somewhat above the head level. Orthochromatic film is recommended for most purposes, panchromatic where the hair is very dark or very fair. Filters are not necessary.

Q. **I have a 616 Kodak Special camera with *f*/4.5 Kodak Anastigmat lens. There are some small air bubbles in one component of this lens. Does this indicate an imperfection; will it cause any defects in the pictures?—H. R. E.**

A. When we answered a similar question some time ago saying that small air bubbles would have no practical effect on the image, we were "jumped" upon by a reader. We are taking no chances this time and will quote from others. L. P. Clerc, Hon. F. R. P. S., in his "Photography, Theory and Practice": "Beginners have a tendency to consider the bubbles seen in *every* anastigmat as a defect. The sole effect (of these bubbles) is to diffuse about one thousandth part of the light — an absolutely negligible amount." E. J. Wall, F. R. P. S., in his "Dictionary of Photography": "A lens is not necessarily bad when bubbles are present in the glass, but it is the exception for a high-class optical firm to send out a lens in which *large* bubbles are visible, although a number of small bubbles may be present in a high class anastigmat without being any practical disadvantage." Henney and Dudley's "Handbook of Photography": "Bubbles in a lens generally act merely as direct obstructions to light and, unless of unusually serious magnitude, are insignificant." So there!

Q. **We understand that there is a special type of film used for copying manuscripts. Can you inform us on this subject? Also, what size camera would give best results when copying pages up to 8½ by 11 inches?—W. L. P.**

A Any camera from the 35mm miniature type up may be used for copying manuscripts, the camera lens being suitably supplemented with tubes or close up lens or simply by extending the bellows of the camera. In the latter case, the longer the available bellows extension the more versatile it is in this regard. For the miniature cameras, positive film should be used for your purpose. In the larger size cameras, commercial or process film is used.

Q. **I own a Linhof Technika, size 9 by 12cm, with a Zeiss Tessar *f*/4.5, 15cm lens. My problem is what lens to purchase for portraiture. Can I use a telephoto lens? Many say a telephoto will not give me the perspective of a long focal length lens, that I will have a larger image, but with distortion. Could I use a simple rapid rectilinear lens which is of 10-inch focal length?—C. F. P.**

A The rapid rectilinear lens will do the trick very well, but of course, the slowness of the lens, usually *f*/8, may be somewhat of a deterrent in portraiture, particularly where children are concerned. However, if the lights are strong and near enough to the subject and you employ the very fast film emulsions, this should prove no great handicap. So far as distortion is concerned, this is caused by a near viewpoint and not by the design of the lens. At a good distance from the subject, say eight feet or so, there should be no distortion in perspective with a telephoto lens.

OUR BOOK CORNER

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PARTNER OF NATURE

By Luther Burbank

COMPILED and compressed into one volume, this is a collection of the famous plant breeder's writings The principles of plant breeding, rivalry of plants, new flowers and new colors, harnessing heredity, breaking the rules, planning a new plant, interesting failures, fixing good traits, building a new fruit, plums, berries, practical pollenization, seedling propagation, grafting and budding—these are the chief subjects covered, all in a direct, unpretentious and non technical way (315 pages, 5½ by 8 inches, 29 illustrations)—$3 10 postpaid—*A G I*

THE PHOTOGRAPHIC PROCESS

By Julian Ellis Mack and Miles J Martin

DESIGNED as a text book for college use, the thoroughness and systematic treatment that has gone into the preparation of this book will be appreciated as well by the general reader with a genuine curiosity to know just what makes photography tick In the words of the authors, the book is "not intended to be either a handbook of practical methods or an exhaustive reference work," but "is concerned chiefly with the principles and basic techniques of the process" (586 pages, 7½ by 10¾ inches, 15 full page photographic reproductions, numerous illustrations) — $5 10 postpaid — *J D*

THE OSCILLATOR AT WORK

By John F Rider

THE idea behind this book, as stated in the author's foreword, is to get the users of oscillators and signal generators better acquainted with these instruments — how they function, the uses to which they can be put, and how their performance can be checked The first nine chapters are devoted to descriptions of the several types of vacuum-tube and electro-mechanical oscillators which are in common use today The tenth chapter deals with the modulation of oscillators, with particular attention paid to frequency modulation, which is becoming of increasing interest in the communication field The next two chapters consider the requirements of signal sources in regard to their design and performance. Chapter XIII tells how to check the various types of signal sources and the different troubles which might arise Inasmuch as this book is aimed at the radio serviceman, a chapter is devoted to the testing of receivers and the part that oscillators play therein The last chapter describes the various oscillators that are incorporated in superheterodyne receivers and how they can be checked Many different laboratory tests are described in the Appendix This book should be of particular interest to the student and laboratory worker who desires a better knowledge of oscillators and signal generators The functioning of these instruments is clearly explained without the use of intricate mathematics and the latter portion of the book should prove of great value (256 pages, 5½ by 8½ inches, illustrated) —$1 60 postpaid — *A P P*

THE PHILOSOPHY OF JOHN DEWEY

Edited by Paul Arthur Schilp

SEVENTEEN great thinkers, including Bertrand Russell, George Santayana, and A N Whitehead, scrutinize the writings of the great American philosopher, and at the end Dewey writes a rejoinder All this constitutes virtually sitting in a university seminar with Dewey and his outstanding critics (708 pages, 6 by 9 inches, one illustration) — $4 10 postpaid — *A G I*

PRACTICAL ELECTRICAL WIRING

By H P Richter

RESIDENTIAL, farm, and industrial wiring of all types of electrical equipment from the simplest socket to electric motors and transformers is discussed One section is devoted to theory and basic principles, another to actual wiring, residential and farm, and a third to actual wiring, non-residential projects A highly practical, well illustrated book for every technician (503 pages, 5¾ by 8½ inches) — $3 10 postpaid *F D M*

TELEVISION

By V K Zworykin and G. A Morton

"ELECTRONICS of Image Transmission," the subtitle of the present book, is a simple yet accurate statement of its content. In the text, the authors have gathered the scattered literature regarding electronic television and have presented it in compact form for the reader who desires a detailed survey of this newest of practical means of communication. The book is divided into three general parts: fundamental physical phenomena, the field of television as a whole, and an analysis of the components of electronic television. This is a thoroughgoing book that requires study if the reader is to gain the greatest benefit. (646 pages, 6½ by 9½ inches, thoroughly illustrated with drawings and photographs) $6 10 postpaid — *A. P P*

WOODWORKING AS A HOBBY

By Emanuele Stieri

PRACTICAL instructions for planning a workshop, choosing and using hand tools, are followed in this manual by detailed chapters on the use of the bench saw, lathe, jig saw, jointers and shapers, and the drill press Other chapters deal with types of wood, making joints, wood finishing, and using glue Final chapters describe projects such as shelves, coffee table, magazine rack, corner cabinet, pipe rack, and gate-leg table The book is by a man who obviously has used the tools, not merely an "armchair" woodworker (268 pages, 4½ by 8 17/64 inches, 227 illustrations) —$3 10 postpaid — *A G I*

THE STOREHOUSE OF CIVILIZATION

By C C Furnas

MEATY is the outstanding word with which to characterize this book which will be widely read by thinking people and kept for reference afterward It combines with a comprehensive view of our natural resources—minerals, plants, animals, fuels salts of the sea, and energy from the sun — a mature discussion of the problems of converting them into the goods and services of our civilization The long chapter on social impacts and implications will provide much food for thought to those who like to think, likewise will the long chapters on the chemical age (synthetic compounds) and on the energy supply (562 pages, 5½ by 8½ inches 38 charts, 14 figures) — $3 35 postpaid — *A G I*

HOW TO DESIGN AND INSTALL PLUMBING

By A J Matthias, Jr

ALL types of plumbing for the farm as well as for metropolitan houses and buildings Includes details of installation of all piping and equipment for sanitation and for drinking water Latest types of farm disposal units are explained in detail (388 pages, 5¾ by 8½ inches, over 300 illustrations) — $3 10 postpaid — *F D M*

NO LIFE SO HAPPY

By Edwin Lewis Peterson

TO the trout fisherman, as to few other men, the pleasures of retrospection and anticipation rank high among the fascinations of his favorite sport The author of

We can supply our readers with any of the books reviewed in this department. Prices quoted include domestic postage. Foreign prices are necessarily higher due to increased shipping charges.

SCIENTIFIC AMERICAN
24 West 40th Street New York, N. Y.

FOR OTHER BOOKS YOU WANT, SEE PAGES 294 AND 307

this volume so successfully awakens memories of sights, sounds, and smells of the stream as to cause the angler-reader to ruminate nostalgically on piscatorial adventures of the past, and simultaneously to anticipate more extensive angling excursions in the future The author has aptly said "It is nothing to those who do not feel it, it is everything to those who do" This is a book packed with sound fishing lore, wrapped tastefully in a series of experiences concerned with a quest for the giant trout, "The King" W J Schaldach has provided nine illustrations in harmony with the outdoor spirit of the book (221 pages, 5½ by 7¾ inches) — $2 60 postpaid —*A D R, IV*

EXPERIMENTING AT HOME WITH THE WONDERS OF SCIENCE

By Eugene Hodgdon Lord

MANY of the simple home experiments on which noted scientists of today cut their eye teeth are collected in this excellent volume of 98 interesting "tricks" They include such things as boiling water in paper bags, chemical fires, matches that won't burn, flame-proofing cloth, making sugar crystals, telephoning through a string, magic handkerchiefs, chemical gardens, and electricity and magnetism An excellent volume for the youngster with a mechanical bent, and for hobbyists (243 pages, 6½ by 8 inches, well illustrated) $2 10 postpaid *F D M*

THE COMPLETE GUIDE TO SOILLESS GARDENING

By Dr William F Gericke

IT had to come — this comprehensive and authentic guide by the man who invented soilless gardening Others have followed Dr Gericke's footsteps in experimentation and a number of books have been written by them, however, here is the complete discussion of all phases of this fascinating work from start to finish by the one man who should know most about the subject It tells what the grower, amateur or professional, wants to know concerning chemicals, apparatus, various crops and flowers, with also a chapter on the economics of this new scientific method of growing food plants (285 pages, 6 by 9¼ inches, 59 photographs) — $2 85 postpaid *F D M*

THE BOYS' BOOK OF PHOTOGRAPHY

By Edwin Way Teale

ALTHOUGH this book is directed particularly at the younger amateur photographer, it should find many readers among those older in years yet young in experience It runs the whole gamut of photography from history to modern practice Not only is the reader told how best to handle his camera but is also guided briefly, yet sufficiently completely, through the simple phases of darkroom work that will enable him to go on to more advanced fields The text is written in a light vein, in many cases it touches much too briefly on certain aspects of the subject, but this is not too much of a drawback when the scope of the whole book is considered. (252 pages, 5½ by 8½ inches, a large number of drawings and full page photographic reproductions.)—$2.10 postpaid.—*A P P*

TELESCOPTICS

A Monthly Department for the Amateur Telescope Maker

Conducted by ALBERT G. INGALLS

READERS of this department will recall the description, published here in April, 1939, of a 10" off-axis reflecting telescope made by Norbert J Schell, 1019 Third Ave, Beaver Falls, Pa, around an off-axis mirror made by T G Beede, Youngstown, Ohio—a mirror figured the same as if it were a section cut out of a larger mirror and to one side of the center Figure 1, reproduced from that description, will recall and explain this telescope In use, it gave refractor performance in a reflector, because diffraction from the diagonal was eliminated, as was astigmatism, the short coming of the crude Herschelian

The same team—Schell and Beede—have now gone one step further—the criss-cross off-axis telescope Schell writes

"Here is a sketch (Figure 2) of the horrible details, also photographs (Figures 3 and 4), of this telescope as it appears when put together in a rectangular plywood tube The performance is pretty sweet—better than the simple off-axis You ask me to tabulate the specific advantages Here they are:

1. Long focus primary—easier to figure than short focus

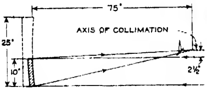

Figure 1 The off-axis principle

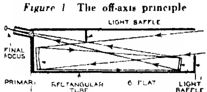

Figure 2 Criss-cross principle

2 Folded back focus, a là Cassegrain—most convenient observing position

3 Flat only half the size of the primary—easier to make than full size

4 Tube length only half as long as focus

5 Disposition of surfaces permits light baffles, eliminating any light not reflected from primary

6 Wooden tube better than metal Also, because of the shape of this tube, most of the light is kept away from sides of the tube, reducing tube air current troubles

"This combination of mirrors can be arranged for use of a warmed observing room by shooting the light from the flat up the polar axis—no added reflections being necessary

"This arrangement of a long focus mirror and half size flat was thought up by Beede The only part I contributed was to twist the main mirror around 180° and thus bring about the criss-cross feature

"No particular trouble was encountered in getting a good alinement

"The mounting shown was made in a

Figure 3 Criss-cross, in the flesh

Figure 4 Eye end of criss-cross

hurry, to try out this design It is stiff enough, but no considerations of appearance went into it

"The 10" mirror works as a section of an imaginary paraboloid of 46" diameter This is necessary in order to get far enough off axis to introduce the 6" flat at the position wanted without obstructing the light reaching the primary

"The primary mirror has a 148 1/2" focal length and is offset 19" from the theoretical axis The 6" flat is 67" from the primary and the focus is 81 1/2" from the flat "

MORE of Beede's mirror work "Enclosed," writes Leo J Scanlon, of Valley View Observatory, 186 Van Buren Street, Pittsburgh, Pa, "are pictures (Figures 5 and 6) of a 6" Cassegrain telescope—the world's best—made for me as a token of appreciation by two other amateurs The 6" mirror and secondary were made by T G Beede of Youngstown, the mounting, tube, and tripod by Emmor Kelley, of Brownsville, Pa, (he of anniversary whistle clock fame—see this department, Oct 1938) Beede did a perfect job on the mirrors, and Kelley has produced the finest telescope of his career.

"The tripod has tension-taker-uppers at the headjoint to make it secure The legs are braced by a special device attached under the tripod head

"The tube is of Micarta, cloth base, finished in several coats of black Duco rubbed to a satin surface It is removable from the mounting, this being done by unscrewing the two trunnion bolts Incidentally, these can't fall out when unscrewed The cell has a ventilating plate (Figure 5) which can be opened or closed at the turn of a knob near the eyepiece.

"The yoke was fabricated by welding 2" tee-section steel girders and is exceptionally rigid. The slow motions in RA and declination are velvet smooth and have no backlash, as there are provisions for eliminating this or for applying tension to the bearings in both coordinates. The tripod head and polar axis housing are of cast aluminum.

"The only contribution I made to the telescope," Scanlon continues, "is the method of adjusting the secondary mirror I gave Kelley the idea and let him work it out—so all the credit for its success belongs to him The secondary mirror is held by the usual fins to a ring This ring can be tilted in any direction, or made to approach or recede from the main mirror, by using a screwdriver on three adjusting lugs at the eyepiece end of the telescope, through the holes shown by the arrows (Figure 5) Turning these lugs operates a left-right bushing at the ends of the rods supporting the framework for the secondary This framework (Figure 6) slides down into the tube and is guided and spaced by additional lugs bolted to the inside of the tube itself The secondary adjustment is then quite simple, just remove the eyepiece and look in while you adjust with a screwdriver from the rear of the cell Any slight error of adjustment is immediately corrected You can

Figure 5. Beede-Kelley to Scanlon

Figure 6: We too think it's great

Figure 7. T. G. Beede testing mirror

Figure 8 Beede and 20" cellular

line it up perfectly while looking at a star I think it's great!

"Figure 6 also shows the light shield for cutting off direct illumination from the field to the eyepiece, during daytime use—though it is left in permanently"

Concerning tubes such as the one used on this telescope, Scanlon writes. "There are two kinds of tubes available at the Westinghouse Company in West Pittsburgh, Pa. One is a laminated Micarta paper tube rolled under pressure on mandrels and glued with a Bakelite varnish The other, also Micarta, is a cloth material wound on a mandrel in similar fashion, same varnish binder of Bakelite cement Each is baked to harden and is quite as strong as aluminum, without the metallic drawbacks"

For several years your scribe has been hearing echos of Beede, of Youngstown, Ohio, mentioned above in connection with two telescope descriptions, generally from the direction of western Pennsylvania. Leo J. Scanlon some time ago told your scribe that he was an old-time worker of most remarkable skill. N. J. Schell, mentioned above, also discovered him and so did others. Yet, never a written word or a syllable came from the man himself, until one began almost to believe him legendary, like Homer Thanks to Schell, who has now provided some requested personality notes, and to Beede's sidekick, Leo F. Grandmontagne, Box 833, Youngstown, Ohio, who finally managed to get him to submit peaceably to being photographed (Figures 7 and 8), Beede comes at last into focus.

He is about 68 years old, a retired master

plumber and plumbing contractor, and started making mirrors in 1898, after visiting an elderly clergyman named Dr John Peate, of Greenville, Pa, who, after 16 years of mirror making, had cast a 62" mirror, said now to be at the Smithsonian Institution He has been making mirrors ever since, mostly as an amateur He was once visited by Prof Ritchey "Beede does not hurry his work," Schell states, "but when he turns a job loose you can swear by it On jobs, such as flats, his methods are tried and sure, and he carries them through without any back-tracking, and in surprisingly short time considering the quality of the finished product He does all his work by hand

"He has his own methods of preparing Carbo and rouge," Schell continues, adding, "I have seen some of his Carbo that he has floated three hours He does not use emery for finishing, saying it is too slow, and that the fine Carbo produces a better surface anyway He floats his rouge and classifies it as fast-cutting, slow, and so on He makes laps with a pen knife that look like the idealized drawings in the book, then coats them with mixtures of about three kinds of wax He uses coal tar pitch "

Beede is said to have a keen sense of humor despite the relaxed expressions of the photographs "He is an indefatigable worker, with unlimited patience," Schell states, "and can produce a beautiful, smooth optical surface of any kind whatever with perfect edges and correct within limits too close to measure with the knife-edge test, and do it right along He is considered by a host of amateurs who know him as the dean of amateur telescope makers The Mahoning Valley Academy of Science is preparing to honor him for his development of a method for figuring off axis mirrors

"Why hasn't Beede ever told the world about himself?" Schell was asked "He is by no means gabby " was the reply, an under statement

CREDIT is due to William R Harlow, an amateur telescope maker and freshman at Miami University, Oxford, Ohio, for an invention consisting essentially of the application of a stroboscope to a telescope, for improving definition when observing Prof. A E Douglass, director of the Steward Observatory at the University of Arizona, who has had many years of actual experience at the eyepiece in observing Mars both there and at Lowell Observatory, states that he believes the idea fruitful, and it is hoped that other amateurs better situated for trying it out than Harlow will now do so

Harlow states that he has made a 6" reflector, a 10" Cassegrainian, a 6" simple refractor, and then an 8" achromatic refractor, working on the last named from J R Haviland's instructions in "ATMA" Then he tackled his stroboscopic application "A careful examination of the shimmering of an image," he states, "will show that about 75 percent of it is harmonic, the remaining 25 percent erratic, due to the varying air currents." These things are described by Prof Douglass in his chapter on "Atmosphere, Telescope and Observer," in "ATMA" "If some form of stroboscopic disk is interposed somewhere along the light beam," Harlow continues, "with a rheostat control on the disk motor, a lot of shimmering will be stopped.

"The slot in the disk should be a trifle wider than the light beam at the point along the tube where it is applied. With one slot (Figure 9, upper left) a speed of half the motion of the image will stop it, with two slots (upper right) quarter the speed, and so on I found it worked best at the declination axis, where the vibration was least The motor should be cushioned in some way"

Perhaps one's first thought on noting this description is "But won't the illumination of the image be greatly reduced?" No, it would not, as Harlow explains, "because of the persistence of vision—though this would be detrimental in photography where there is no such phenomenon"

J R Haviland, to whom this communication was shown, thought "it really is something, if it works." Professor Douglass

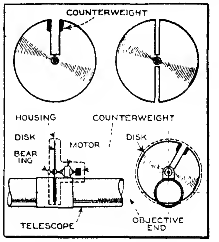

Figure 9 Harlow's strobotelescope

commented as follows "I am a lot interested in Harlow's stroboscopic device I am satisfied that a substantial amount of the flicker in the image is harmonic I think this applies to a star or small object like a satellite of Jupiter [One of Professor Douglass' specialties is the observation of Jupiter's satellites Another is tree ring research, he is the scientist who has dated many old Indian structures in the southwest by means of the rings in the timbers found in their ruins —*Ed*] I suspect that, in the case of a disk the size of Mars", Professor Douglass continues, "the situation is most complicated Atmospheric currents are not so easy to study on a planetary disk as on a star

"Harlow's stroboscopic device will work when the telescope lens is small compared with the wave of the currents in the air, for then you have good definition (but low power, limited by diffraction effects) and a swaying image This stroboscopic device would decrease or stop the swaying of the image and is a very neat idea, but in a larger aperture which covers several or many waves at once this device, as described, would not aid because the image does not sway but is badly confused due to the varying refraction of the many slopes of the air waves, all in the objective at once

"So the device should work for a small telescope, 2 or 3, and sometimes 4 or 5, inches, depending on large size of air waves and freedom from cross-currents or local currents (which I used to call ripples), but with increasing aperture (5 to 10 inches) the results might or might not be good (I am thinking of conditions in a

good climate such as here in Arizona). For bigger instruments, up to the giant reflectors, it would do no good at all. However, the idea is fruitful. Is there any way some harmonic correcting device could be made to work in a big aperture? For example On an observation night make a sketch or a photo of the waves as seen without the eyepiece and in full aperture, transfer this to some dichromated gelatin photographic film on good glass, that displays variable thickness of film without blackening, insert this in the beam and have it vibrate transversely to the waves on a motion found to match the shifting of the waves themselves This would be very difficult It might better be tried the following way Make a film (or choose one of a lot on hand), place it in the beam (by motion along the beam it might adapt itself to the proper size—refractive power of wave slopes would be more difficult to match), and then add the stroboscopic slit of Harlow's, adapting the rate to match the wave changes

"Thus, in short, if a transparent pattern could be made to effect wave correction in some one position of the waves with reference to the telescope lens, then the application of Harlow's stroboscopic device could, I think, be made to pick out the majority of the instants of time when that correction would be an advantage either in photography or visual work"

Commenting on this, Harlow states that he has no facilities to carry the idea further, hence the idea is presented here for other amateurs or professionals to carry on Harlow adds that he had himself discovered what Prof Douglass pointed out—that the effect diminished as the aperture increased, and that he had had better results with his 3" refractor than with his 8" reflector and 10" Cassegrainian, but had not known whether or not this would always be true

WHETHER reflectors with open tubes are superior to those with closed tubes is the subject of a perennial debate Most recent slant on this is found in the January number of *The Journal of the British Astronomical Association*, where Dr W H Steavenson's opinion is pointed out For a telescope which is to be used in the open, the disadvantages of the closed tube would be outweighed by the advantages Most lattice tubes are used under domes, but if used in the open, dewing of the mirror may occur Two other members pointed out that they find that aluminized flats do not dew in the way that silver flats would under the same conditions.

The same number of *The Journal* contains a six page article by M. A Ellison, son of the late Rev W. F. A. Ellison, describing a Hale spectrohelioscope which he has just completed. This is the second in Great Britain, (by an amateur), A M Newbegin having made the first, two or three years ago M. A Ellison says the work required two and one half years, and that the performance has come up to expectations.

THE TELESCOPE, popular astronomical journal, March April number, has a noteworthy, 10-page article on the 200" reflector, by Anderson and Porter. Two thin dimes, Harvard College Observatory, Cambridge, Mass.

STELLAFANE Convention, Sat., Aug. 10.

CURRENT BULLETIN BRIEFS

(The Editor will appreciate it if you will mention Scientific American when writing for any of the publications listed below.)

HANDBOOK OF AERONAUTICAL VOCATIONS, by Walter Van Haitsma, is a 48-page pocket-size booklet that presents facts regarding aviation as a career. In the first part of the book are outlined the advantages and disadvantages which will confront those who seek positions in the aeronautical industry, this being followed by a comprehensive chart which enables the reader to evaluate his own inclinations in terms of possible positions in aviation. A chapter is devoted to schools and another to helpful suggestions. *Zeeland Record Company, Zeeland, Michigan*—25 cents.

FASTER DIESEL POWER is a 32-page catalog, printed in two colors, describing the "HD-14"—said to be the fastest and most powerful crawler tractor on the market. The catalog illustrates the tractor as well as its component parts, and gives details regarding the work which it can do. *Allis-Chalmers Power, Tractor Division, Milwaukee, Wisconsin.*—*Gratis.*

WABASH EXPOSURE GUIDE is a 16-page booklet published for the camera workers who make flash pictures, flood pictures, or home movies, which packs essential information in a small space. All popular roll films, film packs, miniature films, and cut films are listed, together with complete exposure tables. *Wabash Photolamp Corp., 335 Carroll St., Brooklyn, New York.*—*Gratis.*

CHAIN STORE STATISTICS is a 34-page statistical analysis of the history, business volume, capitalization, and current financial position of 30 leading chain store companies. The conclusion is that despite discriminatory legislation, public opinion is placing the stamp of approval on the advantages of the mass distribution services of chain stores. *Merrill Lynch & Co., Inc., 40 Wall Street, New York, N. Y.*

CARNEGIE INSTITUTION OF WASHINGTON, YEARBOOK FOR 1939, is a 394-page summary of the past year's research in astronomy, biology, physics and geophysics, and other sciences as conducted by this nationwide institution.—*Carnegie Institution of Washington, Washington, D. C.*—*$1.00.*

BURKE & JAMES, INC. CATALOG No. 340 is an 84-page compilation of bargains and announcements for camera owners. It lists the items available in the company's 43rd annual spring clearance sale. Fully illustrated. *Burke & James, Inc., 223 West Madison St., Chicago, Illinois.*—*Gratis.*

SMASH HITS OF THE YEAR is a 36 page well illustrated booklet that presents, pictorially and graphically, the facts about automotive accidents in 1939. Special features in the booklet include statistics and editorials on a wide variety of traffic safety phases. The information given here serves to drive home forcefully the necessity for increased vigilance on the part of all those concerned with the operation of motor vehicles. *The Travelers Insurance Company, Hartford, Connecticut.*—*Gratis.*

THE RAILWAY HANDBOOK 1939-1940 is a 96-page paper-covered booklet designed to provide the student of railroading with a concise collection of useful statistics. The chronology of railroad history includes items of outstanding importance. The text is largely concerned with British railway practice but some of the statistics are world wide. *The Railway Publishing Company, Ltd., 33 Tothill Street, Westminster, S. W. 1, England.*—*Two shillings, sixpence.*

LINK-BELT CONVEYORS IN AMERICAN INDUSTRY is a 48 page illustrated book which tells in picture and text of the many different applications of mechanical elevating and conveying equipment for handling both packages and loose bulk material. Easy-to-understand charts show how much better the American worker fares than do workers in other countries, in this particular case the evidence being based on the use of conveyors to make work easier. Request your copy of this booklet, No. 1700, on business letterhead. *Link-Belt Company, 307 N. Michigan Avenue, Chicago, Illinois.*—*Gratis.*

FREQUENCY MODULATION COMPONENTS is a single-sheet bulletin that shows how to construct a unit which permits the reception of frequency modulation transmitters on present receivers. With the adapter described, the audio frequency amplifying system of a standard receiver is employed. All parts are listed, a wiring diagram is given, and prices are quoted. Request Bulletin 105A. *Browning Laboratories, Inc., 750 Main Street, Winchester, Massachusetts.*—*Gratis.*

TYPE K POTENTIOMETERS AND ACCESSORIES describes two types of precision instruments for general laboratory use. It also discusses a number of accessories which are necessary for certain types of procedure. An added feature is the description of the thermionic amplifier which adapts potentiometers to measurements in high-resistance circuits such as those in pH measurements using the glass electrode. Prices are given. *Leeds & Northrup Company, 4907 Stenton Avenue, Philadelphia, Pa.*—*Gratis.*

RAILROAD CAPACITY is a reprint of an address presented by M. J. Gormley, Executive Assistant, Association of American Railroads. The text surveys the entire subject of railroad traffic while an appendix presents a series of graphs which show the problems involved and the results being obtained. *Association of American Railroads, Transportation Building, Washington, D. C.*—*Gratis.*

LIGHTNIN MIXERS is a 16-page illustrated catalog showing a wide variety of mixers for industrial purposes. It includes types which can be adapted to almost any process of mixing, dissolving, blending, washing, and other industrial purposes where a reliable method of mechanical agitation is needed. The catalog describes permanent as well as portable mixers. Make your request for it on your business letter-head. *Mixing Equipment Co., Inc., 1090 Garson Avenue, Rochester, N. Y.*—*Gratis.*

LEGAL HIGH-LIGHTS

Patent, Trade Mark, and Related Legal Proceedings That May Have a Direct Effect on Your Business

By ORSON D. MUNN, Litt.B., L.L.B., Sc.D.
New York Bar
Editor, Scientific American

Corporate Names

WE have previously pointed out on this page that the right of a person to use his name in connection with the operation of his business is not without legal restrictions. Thus, where a person has built up a large business under his family name and the name has become identified in the minds of the purchasing public with his business and product, a new-comer having the same name is not permitted to use his name in connection with a competing business, at least without an accompanying statement explaining that there is no connection between the parties.

The courts are even stricter in applying this principle to the use of a family or personal name by a corporation. This is illustrated by a recent case in the New York State Supreme Court involving a well known designer of dresses. The complainant in the suit was the seller of gowns and dresses made by a well-known designer named Turner and the gowns were known variously as Turner's Gowns or Turner's Creations. Defendant was a corporation engaged in the business of selling dresses and it adopted the name "Turner's Gowns Limited." The defendant acquired its name from one of its incorporators whose name at that time was Pauline Jacobs but who had previously been married to a man named Turner. Since the incorporator's name at one time was Pauline Turner it was argued that the defendant corporation had the right to use the name Turner as part of its corporate name. The Court held that a corporation may not adopt the name of an individual incorporator and use it to deceive the public or to defraud others who have built up a business under the same name. An injunction was granted, restraining further use of the name.

Equitable Morality

IT is axiomatic that he who seeks the aid of a court of equity must come into court with clean hands. In other words, a court of equity will not give aid to a person who has acted inequitably with reference to the subject matter of the dispute that he is asking the court to act upon.

A recent case based upon this principle illustrates that the courts have not as yet been affected by the wide-spread public indifference to or toleration of gambling. The manufacturer of a game of chance similar to a lottery brought suit for trade-mark infringement and unfair competition against a competitor, charging that he was using his trade mark in connection with the sale of a similar game. The competitor made a motion to dismiss the suit on the grounds that the plaintiff was guilty of unclean hands in that he was using the trade mark in connection with the sale of a gambling device. The Court sustained this contention and dismissed the complaint, stating:

"In this case the complaint shows on its face that the complainant seeks the aid of a court of equity in the use of a device universally condemned as iniquitous."

Sawdust Heels

A PATENT for a shoe heel made primarily from sawdust was recently held to be valid and infringed by a federal district court. The owner of the patent brought suit against a shoe manufacturer charging that he was using a heel which infringed the patent. The patent covered a heel comprising a molded block of sawdust and a soluble binder saturated with nitro cellulose. In making the heel the patent suggested mixing hardwood sawdust with glue and then shaping it in a suitable mold under pressure. When the molding operation was completed the heel was then soaked in nitro cellulose. The Court found that the patented heel was new and represented an improvement over prior composition heels and accordingly held the patent to be valid.

Concealment

THE patent laws provide that in any suit for patent infringement there shall be no recovery of profits or damages for any infringement committed more than six years before the filing of the suit. One of the purposes of the law is to prevent a patentee from unfairly permitting an innocent infringer to infringe a patent for many years and then, after the infringement has been built up to substantial amounts, bring suit for patent infringement and recover large damages. However, this provision of law appears at times to work a hardship on a patentee. This is illustrated by a recent suit for patent infringement in which the infringement occurred more than six years prior to the institution of the suit.

The patentee contended that the infringer concealed the infringement from him and accordingly he was not in a position to institute the suit at an earlier date. It was argued by the patentee that the six-year period should be computed from the time that he received actual knowledge of the infringement and not from the actual date of infringement. The Court rejected this argument, pointing out that the provision of law was a positive one and prevented a patentee from recovering for an infringement which occurred more than six years prior to the institution of a suit, even though the infringement might have been concealed. This provision of law accordingly places a rather harsh burden of vigilance upon a patentee; he must not only file suit promptly against a person who openly infringes his patent but also he must discover and prosecute those who are fraudulently and secretly infringing his patent.

Strict Construction

A PATENT that has not gone into commercial use is commonly referred to as a paper patent and is strictly construed by the courts. This is illustrated by a suit for infringement of a patent for a method for heating electro conductive materials in electric welding machines. The patentee charged that the manufacturer and user of a spot-welding machine infringed the patent in suit.

It was pointed out to the Court by the defendant that there were decided differences between the patented machine and process and the machine and process which was charged to infringe the patent. The patentee argued that while there were differences, the machine and process used by the defendant were really equivalents of the patented machine and process. In considering the question of infringement, the Court found that the patent in suit had never gone into commercial use and accordingly was a paper patent and not entitled to a broad construction. Under the circumstances the Court held that the patent was not infringed.

In reaching its conclusion, the Court stated as follows:

"Moreover, considering Thompson's patent as a paper patent, for there is no proof of any commercial use, it must be strictly construed."

Interurban

A FEDERAL court recently held that a manufacturer of street signs using the name "Municipal" as part of its corporate name could not prevent a competitor from using the word "City" in its corporate name. Both of the parties were engaged in the manufacture and sale of highway signs and their principal customers were state governments, municipalities, and other political subdivisions. The plaintiff's corporate name was "Municipal Street Sign Company, Inc." and the defendant's corporate name was "City Street Sign Corporation."

The plaintiff contended that the similarity between the two names would lead to confusion among customers. The Court rejected this contention, however, pointing out that they did not sell to the general public but to government officials who were well informed about the companies from whom they purchased equipment.

In this connection the Court made the following statement:

"We must not forget that it is not the general public that is the purchaser of street signs, but that the purchasers thereof are officials and engineers of public sub-divisions of the State, who would ordinarily be well informed about the company from whom they were purchasing, and would not be deceived by names of such different sounds, even although the meaning of them might be the same."

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The SCIENTIFIC AMERICAN DIGEST

SCIENTIFIC AMERICAN

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NINETY-SIXTH YEAR • ORSON D. MUNN, Editor

CONTENTS • JUNE

12. JUL. 1940.

LOOKING like a giant blunderbus and clumsy (because of the peculiarities of perspective) this 16-inch gun is nevertheless an efficient and deadly weapon at long range. It is part of the permanent defenses of the Panama Canal. Because of its emplacement on land, it is more accurate than would be a similar gun on an attacking battleship. See also page 324

SCIENTIFIC AMERICAN, June, 1940 Vol No 162, No 6 entered at the New York, N Y, Post Office as second class matter June 28, 1879, under the act of March 3rd, 1879; additional entry at Orange, Conn. Published monthly by Munn & Company, Inc 24 West 40th Street, New York City Copyrighted 1940 by Munn & Company, Inc Great Britain rights reserved Subscription price $4 00 per year Canada $4 50 Foreign $5 00 Manuscripts are submitted at the author's risk and cannot be returned unless accompanied by postage

50 Years Ago in . . .

Scientific American

(Condensed From Issues of June, 1890)

CENSUS—"Americans who are loudest in their groanings about several census questions should look at the inquisition to which the Germans are subjected The German year book gives the figures of even the income tax . . The exact rental of each dwelling is obtained, and the average rentals for different conditions are published "

AIRSHIP—"The aerial catamaran herewith represented . . . has two cylinders adapted to hold a buoyant material, and connected by a light frame beneath which is stretched a platform of woven steel wire supporting an electric or other motor designed to drive a rearwardly extending shaft which operates two propeller blades To the outer sides of the cylinders are connected wings, pivotally

mounted on horizontal shafts, the wings carrying racks engaged by annular gears in guideways carried by the cylinders, whereby the wings may be inclined at such angle to the horizontal line as may be desired In operation it is designed that the cylinders shall be just sufficiently buoyant to not quite overcome the attraction of gravity, when, the wings being set at the desired angle, the motor is started to drive the ship by the action of the propeller blades, the upward and downward motion being regulated by the inclination of the wings "

HOW TIMES CHANGE!—"In a recent speech Congressman Atkinson, of West Virginia, said 'If all the ports of entry on both oceans were to-day blockaded so that no vessel could enter them bearing the products of other countries, and war should be declared against us, we could, with our present facilities, produce every munition of war, and every article that we might need for our sustenance for a thousand years'"

SAFETY—"The recent experiences of several steamers plying between New York and Liverpool give renewed emphasis to the call for the invention of new and improved constructions and appliances for saving life and preventing accidents at sea . In the construction of the hulls, in means to ascertain the vicinity of ice in fog, in automatic devices for quickly turning and stopping the vessel, in boats, rafts, life preservers, in means for preventing the sinking of ships, there is abundant room for invention and improvement. Perhaps the greatest want of all is a ship that cannot sink, no matter where or how badly wounded "

WRITING AT A DISTANCE—"One of the marvels of electricity, and one of the most striking of the Edison exhibits at the Paris exposition, was the little instrument which enables the operator to sign a check 100 miles distant. The writing to be transmitted is impressed on soft paper with an ordinary stylus This is mounted on a cylinder, which, as it revolves, 'makes and breaks' the electric current by means of the varying indentations on the paper At the receiving end of the wire a similar cylinder, moving in accurate synchronism with the other, receives the current on a chemically prepared paper, on which it transcribes the signatures in black letters on a white ground "

SMELLS—"By the reaction of sulphureted hydrogen on acetone in the presence of condensation agents is obtained principally trithio-aceton $C_9H_{18}S_3$, and small quantities of a non volatile, definitely crystalline compound $C_{10}H_{20}S_4$, tetrathiopenton At the same time, however, an exceedingly volatile body is formed which possesses a smell so horrible that, in comparison therewith, ethyl mercaptan, ethylenmercaptan, and other volatile sulphides must be considered as faint smelling substances!"

POWER—"The utility of wire rope transmission of power has become widely recognized Not only among the rugged hills and mountains of the East and far West where streams go rushing down through caverns and rocky steeps, where no locations for mills or factories are afforded, is this means of transmission of precious power appreciated, but it is so convenient to use it that we find on the prairies of the West mills being operated at a long distance from water powers by the wire rope A few days ago, on a trip through Nebraska, we noticed a rope stretching for nearly a mile from a water power to a mill that had recently been built adjoining a railroad, the owners finding it much more to their advantage to have it there, with the switching privileges afforded, than at the dam The expense of hauling the flour which is thus saved to them will very soon pay for the system of power transmission "

MENTAL CRIPPLES—"The hardest thing to get on with in this life is a man's own self A cross, selfish fellow, a desponding and complaining fellow, a timid and care-burdened man—these are all born deformed on the inside They do not limp, but their thoughts sometimes do."

AND NOW FOR THE FUTURE

¶ "America's Winged Weapons," a succinct survey of the planes of our national defense forces. By James L. H. Peck.

¶ Seeing with electricity. How the electron microscope works. By Jean Harrington

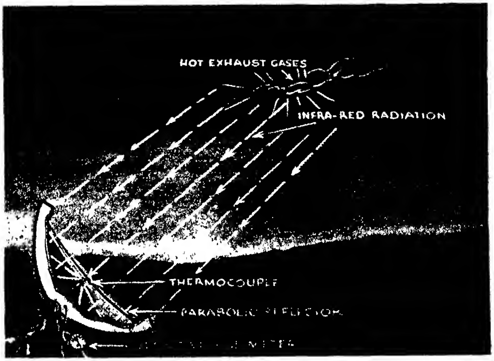
¶ Fighting a war of grinding attrition against friction, man's friendly enemy. By Walter L. Finlay.

¶ Sulfuric acid Its expanding uses measure the progress of nations. By William H. Waggaman

Watch for our new editorial feature. Browsing With the Editor. Significant facts from the broad field of science and industry.

LONG RANGE DEFENSE

PROVIDED we have enough of them, the Army's 16-inch guns could stand off any enemy, for they out-range and out-shoot similar guns on battleships. High elevation gives greater range, while steady, land mounting gives greater accuracy. They hurl shells weighing over a ton more than 30,000 yards.



To detect approach of a plane whose engines are cut off as it glides silently toward its objective, the tool which astronomers use to measure heat of distant stars might be adapted to military use The thermocouple at the focus of the reflector would be affected by heat thrown off from the distant plane and the resulting current noted on a sensitive voltmeter. Even the warm air from a gliding airplane might be detected with this

INVENTIONS WIN WARS

Suggested Developments . . . To Detect, Defeat Warplanes, Submarines . . . Humanitarian Aspects . . . Physical Principles Which Inventors Must Follow

By MAJOR WILLIAM H. WENSTROM

WE live today in the midst of a world-wide struggle, declared and undeclared, between peace-loving democracies and aggressive totalitarians. The sympathies of most Americans, needless to say, are with those nations which are struggling for "life, liberty, and the pursuit of happiness."

However they may lag behind in the matter of armament, regimentation, and general blood-thirstiness, democracies which encourage free and inquiring minds among their citizens should at least excel in the very important quality of ingenuity. American free-lance inventors, for example, are renowned the world over for their intelligence, persistence, unconventionality, and sheer weight of numbers And however we Americans may hate the macabre business of war itself, there is plenty of sober reason, these days, for American inventors to give serious thought to military and naval inventions. Inventions that serve to check those premier weapons of sudden and secret attack—the warplane and the submarine—may even classify as works of true humanitarianism. Herein are a few suggestions. Though most of the basic ideas suggested to American military-minded free-lances in this article are essentially simple, their practical development would, needless to say, entail plenty of painstaking technical research

As to possible war-winning inventions, the inventor can save himself no end of time and trouble at the start by writing off the slate as illusory the three weapons most dear to the hearts of feature writers and movie scenarists: (1) a super-lethal gas, (2) a super-powerful explosive; and (3) a "death ray" capable of killing men, or disabling tanks, airplanes, or ships at a distance.

DEVELOPING either a super-lethal gas or a super-powerful explosive is hazardous enough in a large plant equipped with adequate safeguards. For the average free-lance, such work would be prohibitively dangerous. Despite all the organized research lavished on these two projects, so far as I know, no new wartime gases have been developed since 1918, and "atomite" (the latest high explosive) is only a third more powerful than 1918 trinitrotoluol, or TNT

In principle, the much publicized "death ray," perhaps first described by H G Wells in his fantastic story of invading Martians, is simply a closely compacted beam of electro-magnetic radiation, or radio waves The wavelength depends on the target, which must "resonate" to it for maximum current and voltage effects within itself For man-targets, a wavelength of 3 to 4 (or 1½ to 2) meters might be used For average warplane-targets, a wavelength of about 40 (or 20) meters might be suitable (assuming 65 feet wing spread)

Very simple, so far Bugs and mice, perhaps, actually have been killed with "death rays" of a sort. All you have to do, to bring down a German bomber flying over London, say, is to direct upon it a *sufficiently powerful* radio beam at perhaps 20 meters wavelength, or 15 megacycles per second frequency But wait a minute There is the slight consideration of electric power To bring down that German bomber by this method may take about all the electric power in Great Britain, or possibly all the power in the British Empire, to say nothing of a lot of super-powerful vacuum tubes as yet undeveloped Perhaps it would be simpler and cheaper, after all, to shoot that bomber down with a battery of very efficient British 3.7-inch anti-aircraft cannon

The standard airplane locator, in wide use by the world's armies today, is a very simple device operating on the principle of audio frequencies or sound waves.

In the regular military instrument, a cluster of four large horns is mounted on a universal pivot, the mouths of the horns being pointed at the noise-producing airplane, and the small ends of the horns being led to earphones on two men, either with or without the aid of audio amplifiers. The horns are then in effect two pairs of magnifying ears, one pair giving the plane's azimuth angle, and the other pair its altitude angle. An airplane can be detected and located by this device at distances of 10 miles or more, *provided* that the airplane's propeller, as well as its motor, is turning over at somewhere near normal revolutions.

Silencing the airplane engine alone does not avoid detection, for at modern high speeds most airplane noise actually comes from the propeller. If the pilot throttles back his engines, however, and glides silently in towards his objective from high altitude, that is a horse of a different color which calls for a locator of radically different design. Even so, the standard audio locator still has a fleeting chance because the pilot must occasionally "gun" his motors unless he wishes them to choke up.

Telescopes and binoculars are, of course, widely used, but there are definite and rather low limits to distant seeing by this means. This limitation is largely due to the extreme shortness of light waves compared with the molecular structure of the atmosphere and of the particles suspended in it.

In ordinary diffused haze, yellow filters on binoculars help slightly. Red filters, passing only the longest visual wavelengths, help considerably, they are, in fact, standard practice for all long-range aerial photography. But through very dense haze or fog, or clouds, involving larger particles of liquid or solid, no visual filter will enable us to see. Nor is near infra red photography much more effective.

Anyone who has ever ridden in a high-powered airplane at night has noticed large blue flames streaming backward out of the engine exhaust ports. These flames mean plenty of heat (or infra-red) radiation — on a wavelength somewhere around one thousandth of a centimeter. Hot, exposed cylinders or radiators also mean infra-red radiation, and so does even the warm air streaming backward from these parts.

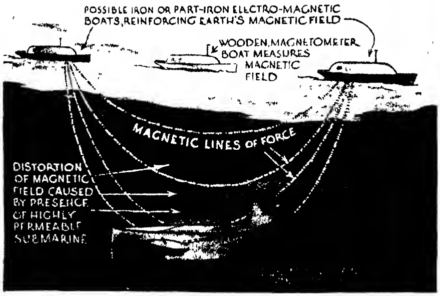
The most sensitive known detector of heat waves is the thermocouple — an electrical junction between two wires of dissimilar metals. For maximum sensitivity and directional effect, the thermocouple itself is placed at the focus of a large parabolic reflector. Such an arrangement can be made so amazingly sensitive that it will indicate the heat radiated by a candle several miles away. For airplane-locating, two or three of these thermocouple units, each mounted on horizontal and vertical degree-scales similar to those on a theodolite, might be set up at known ground locations. The airplane's position in free space would then be found by triangulation.

As another possibility in airplane detection-and-location, rather remote at the present time, how about using electro-magnetic waves still longer than infra red — ultra-short radio waves of a wavelength, say, somewhere around half a meter, or 50 centimeters? Or possibly somewhat longer waves around 5 meters? On the 5 meter waves, the design of a transmitter and receiver circuits is easier and cheaper. But on the 50-centimeter waves, necessary parabolic reflectors, beam antennas, and other arrangements for three-dimensional direction finding receivers are more compact, easier to handle, and less expensive. The general idea is somewhat similar to the new radio echo altimeter used on modern airliners, operated in reverse. Radio engineers and amateurs have already noticed occasional queer ultra-short-wave radio "reflections" that seemed to come from airplanes passing overhead.

Suppose we have, in the center of London, say, a high-power, ultra-short-wave radio transmitter capable of sending out periodically repeated short tick signals of some characteristic form. Suppose we have, further, in the surrounding countryside, at distances of 20 or 50 miles outside the city, several suitable radio receivers, preferably of directional type. The receivers could be elevated to get both direct signals and those reflected from high-flying planes, or they could be placed beyond the bulge of the horizon where signals will be received only by reflection from airplanes. (The direct signals would be useful for timing, but might cause too much interference with the reflected signals.) In either case, two or three directional receivers might be able to locate the enemy airplanes closely enough to hang up an effective H-E barrage. Or the triangulation might be made indirectly from time differences.

Anti-aircraft battery in action, with equipment to direct artillery fire

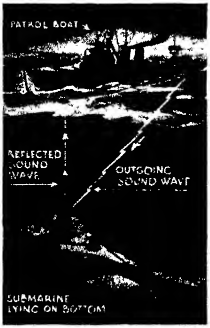
Submarines are particularly menacing to nations whose security depends on sea power — nations such as Great Britain and the United States. The standard method of locating submarines from surface patrol boats, derived from 1918 practice, depends on the underwater transmission of the noise from a submarine's propeller. The sound pick-up is a binaural pair of under-water microphones, preferably spaced several feet



A silent submarine on ocean bottom would indicate its presence by diverting magnetic lines between two specially equipped ships, as the author explains

apart, and similar in principle to a pair of under-water ears.

This method is wholly dependent upon the submarine's maintaining some engine revolutions, which it must do to maintain depth in deep waters such as most of the Caribbean Sea or the Pacific Ocean But in shallow waters, such as the American or European coastal areas of the Atlantic, a sub can lie quietly on the bottom for hours at a time, undetected by ordinary hydrophone methods

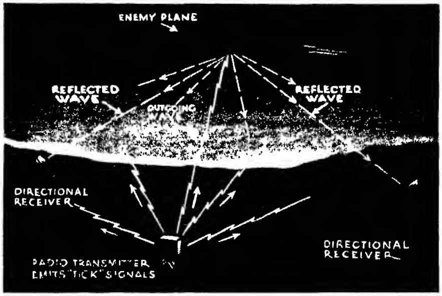


Echo-sounding equipment could be used to locate hidden enemy subs

But aside from these present methods, there are two physical principles by which we might make the submarine disclose its presence involuntarily even if it is not obliging enough to turn over its propeller One is the principle of under-water sound reflection now in standard use as echo sounding gear on most warships and many larger merchantmen

Standard echo-sounding apparatus records a continuous graphical trace of the bottom over which the ship is cruising — by sending out a sound tick from an underwater "loudspeaker" (repeated at intervals of about a second) and measuring the time it takes the tick to travel (at about 5000 feet per second) first down to the bottom, whence it is reflected, and then back upward to an under water microphone on the ship. Set for 100-fathom maximum depth, the ordinary echo sounding gear traces a continuous profile of the bottom as the ship steams ahead at full speed, and clearly indicates a rock, a ledge, or other obstruction on a level bottom, provided the obstruction has a height of at least five fathoms (30 feet). This is somewhat more than the height of a submerged submarine lying on the bottom.

An ultra-sensitive echo-sounding set, with magnified depth change indication, could perhaps be installed as standard equipment on submarine-chasing patrol boats Where a submarine is suspected of lying quietly on the bottom the patrol boat could cross and recross over the suspected area at high speed meanwhile running the sounding set continuously Whenever a small peak on the depth curve indicated a bottom-hugging U-boat, depth charges could be let go Of course any submerged rocks ledges or wrecks should if possible, be charted in advance, lest they give false alarms



"Tick" signals sent out regularly by short wave would be reflected by an unseen plane picked up by several stations, and the plane then located by triangulation

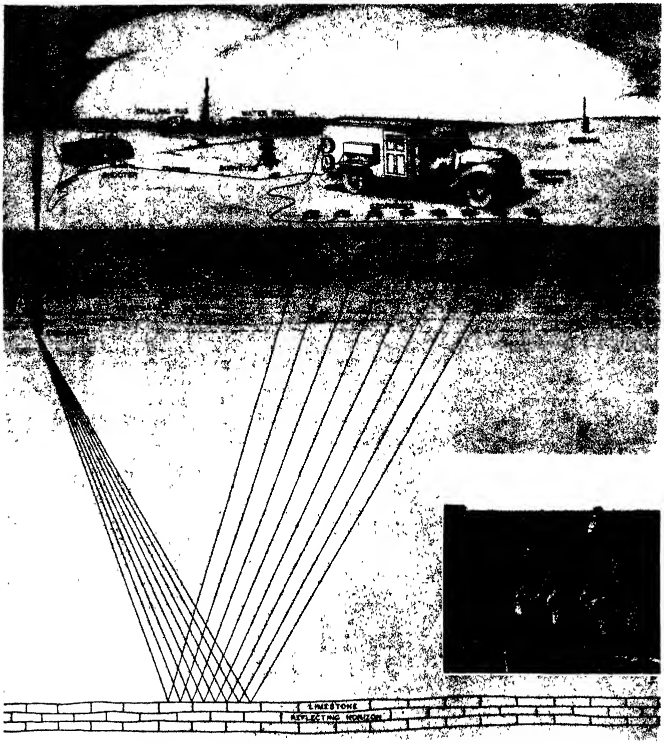
There is still another physical principle that might be used in locating submerged and silent U-boats magnetism and permeability The equipment required here would be considerable — in addition to the usual armed patrol boats, a small wooden ship completely non-magnetic and equipped with ultra-sensitive recording or indicating magnetometers. And possibly two additional ships — part-iron craft equipped with powerful electric generators and wire wound so that the whole boat is nothing more than a powerful electro magnet of the bar type

EVERY student in college physics has performed the experiment of drawing on paper, by means of iron filings or small compasses, the magnetic field between two bar magnets, and every student knows, too, that introducing a piece of highly permeable substance, such as iron or steel into this magnetic field will tend to pull the lines of force into itself, thereby distorting the nearby lines of force Very well then — suppose a submarine is lying on the bottom at a depth less than 50 fathoms (300 feet) The wooden magnetometer ship cruises around the suspected area on the surface, making precise magnetic measurements of the earth's field with ultra-sensitive indicating or recording magnetometers In the vicinity of the submarine (and most noticeably, directly above it) the magnetometers should show a sudden change in the direction or intensity of the earth's field due to lines of force being distorted towards the submarine by its high magnetic permeability

As an alternative method, considerably more complicated but possibly more effective, the two part-iron electro magnet ships could be formed in column perhaps 500 yards or so apart, N (bow) pole of rear ship lined up with S (stern) pole of leading ship, the local magnetic field so created preferably reinforcing, so far as possible, the earth's magnetic field The wooden magnetometer ship could then hold station midway between the two electro magnet ships, making continuous magnetic measurements as described above

The magnetic method would, of course, be slower and more complex than the echo sounding method. But being immune from the blandishments of rocks and ledges it would perhaps be more certain, except for faulty indications due to any submerged wrecks of iron and steel ships

If you want to succeed as a free-lance inventor, in war or peace, don't follow the customary and well trodden paths — there the great laboratories and the formal organizations naturally have you licked from the start But remember also that most of these organization scientists and team technicians have to keep their noses very deep in their own particular little ruts so that often they have neither the time nor the energy to see the woods for the trees So Mr Free-Lance, keep your eye on the woods as a whole, keep your viewpoint fresh and unjaded, and look for the new angles the at-first-sight-impossible angles, the angles that will drive quickly around those too-well-known stone walls into which big research teams are butting their collective heads



Set-up of equipment for seismographing and, inset, placing the seismometers

Seismographing For Oil

THE seismograph used in the search for new petroleum deposits derives directly from the seismograph employed in earthquake seismology to record the location and intensity of earthquake shocks Seismographs have been used by the oil industry for many years and have aided in the discovery of some of the world's greatest oil fields

At the present time exploratory crews sent out by The Atlantic Refining Company are employing seismographs in an area in northeast Texas to determine the location of underground formations of the type in which oil is usually found.

In modern seismographic reflection shooting a charge of dynamite is placed in a hole drilled to a depth of from 40 to 100 feet The firing of the charge creates a sound wave which spreads out in all directions Each time the wave encounters a different reflecting stratum a small amount of energy is reflected back toward the surface.

The reflected vibrations are picked up by seismometers or geophones, amplified by vacuum tubes, and photographed on a strip of paper Study of the photographic record, including the time it takes for the sound wave to reach the various strata and be reflected back again, makes it possible to chart the geologic characteristics of the subsurface The charts, in turn, lend themselves to the selection of drilling sites over formations of a type favorable to oil deposits.

OUR POINT OF VIEW

Patent Sesqui-Centennial

SAMUEL HOPKINS, of Vermont, was granted the first United States patent in 1790 That was just 150 years ago this year In the years since then there have been a total of more than 2,200,000 patents. Only 9957 of these were granted before the patent system was revised and refined in 1836, but in the last 50 years alone, 1,799,000 were granted, or more than four times as many as in the first hundred years

This evidence of the importance and "workability" of our patent system makes difficult of understanding the many attacks levelled at it in recent years That the protection it affords the inventor has spurred the enterprise of the nation seems conclusively proved. And why not? It was set up "To promote the progress of science and useful arts by securing to inventors the exclusive rights to . their discoveries" Those exclusive rights have provided the incentive for vast developments in many fields, has given us numerous new industries, and promises to give us many more The example of one automobile manufacturer, The Ford Motor Company, is illuminating Commenting on the 28,000,000th Ford, the *New York Times* said that, since 1903, the Ford Motor Company has paid out in wages $4,230,000,000, purchased materials costing $10,000,000,000, while the government has received taxes of $700,000,000

Multiply these figures by the number of cars of all makes produced, and by all the other new industries made by inventions of new things or of improvements on old ones, and the picture is extraordinarily impressive Invention and the safeguards of the Patent System are the basis for this vast success

Perhaps changes in the Patent System may be necessary They should not, however, be made willy-nilly by politicians They should be made only after thorough and judicious study of the facts by experts, not as a result of prejudice by dilettantes and social reformers It has been a good system that has poured untold billions of dollars into the pockets of farmers and miners, investors and wage-earners, all those who have been and are touched by the fingers of our enormous industrial system It should not be cast aside lightly, nor ripped apart by unwise hands —*F D M*

Opportunity

PART of this month's piece on the current and important question of television, supplementing that on page 265 of last month's issue, takes the form of a one-act playlet of comedy and pathos (All dialog is fictitious, based on fact)

Federal Communications Commission "You television experimenters have shown some progress, so we are going to let you put on semi-commercial programs, starting next fall "

Radio Corporation of America "Whee! Let's go, boys "

Business of preparing and publishing advertisements of television receivers, telling what has been accomplished and what is in store for lookers-in Also of reducing prices so that John Public will be better able to purchase receivers

FCC: "Stop! You have been bad boys We don't like your advertising. You are actually trying to get the public to buy your equipment You have taken advantage of our ruling. We take it all back. You can't go on commercial schedule until we investigate you and find out why you actually want to sell receivers."

Curtain.

In the figurative lobby after the show, a member of the commission made the following statement, as reported by the daily press· "Should the market be saturated with 30,000 receivers of one manufacturer, sold on the installment plan and promoted by a sales campaign and pep talks, any other set maker entering the market at a later date would be handicapped and retarded, wouldn't he?"

Wouldn't he? You're darn' tooting he would! And why shouldn't he be "handicapped and retarded." Since when has the American business method been to wait until all late comers have had an opportunity to take every advantage of the pioneering work done by others? Since when has it been the practice to penalize initiative and gumption, to crack down on those who have blazed the trail, and to hand ready-made success to Johnnies-come-lately?

Television has always had a warm spot in our heart We have watched it from the time when it was a pup, its eyes literally unopened We have seen it take its first staggering steps, its eyes still far from perfection. We have rejoiced at its first blurry successes, its first crude and flickering pictures. We have drunk a toast to its 441-line pictures that were good. We uttered a cheer when the FCC said go ahead And now comes the ultimatum that the pioneers in the art cannot reap where they have sown, for fear that someone else in the industry may be "handicapped and retarded."

Words fail us, our typewriter stutters in protest at the words we would put on paper "Handicapped and retarded," indeed! It is high time that citizens of this country, official and private, awakened to the fact that business and industrial progress must not be penalized by bureaucratic methods which prefer pseudo-solicitude for the public to the application of those doctrines that, in the past, have brought to us the end-products of scientific research and development --*A P P.*

Let's Look At It Selfishly

WHEN an argument arises as to whether or not it is right and proper that American aircraft factories should supply planes to foreign nations, there is one phase of the situation that should not be forgotten

Whether in peace or war, it is highly desirable that this nation should have available the best possible aircraft In peace, we need reliable air transportation, in war, we need the finest available air defense The only way in which these ends can be achieved is through experience—experience in design, in construction, in flying It should be obvious that neither the transportation industry of this country, nor its military forces, can afford to spend more than a certain maximum in acquiring this experience If, however, foreign nations purchase our airplanes in large numbers, we become the gainers in more ways than one

First A profit is realized on each sale, part of which may be turned back into the industry for research in improved designs Second This constant improvement in design will keep us one step or more ahead of possible enemies Third. More orders mean greater production facilities which, in turn, place us in a highly advantageous position in case of trouble Fourth, and most important of all. Operation of aircraft under wartime conditions reveals needed improvements that might never be found under routine testing

Every thinking American sincerely hopes that the United States will be able to keep out of foreign entanglements; at the same time, he realizes that we must be prepared at all times to defend our own country when and if the pressure becomes too great. With aerial warfare daily becoming a more important part of the military scheme of things, it behooves us to keep our powder dry We can best do this, as far as air power is concerned, by taking our profit in the foreign market and applying it to the upbuilding of our own air equipment.—*O. D. M.*

HISTORY IN A BOG

Forest Managers Beginning to Use a Method of Long-range Climatic Prediction . . . Based on the Study of Fossil Pollen Grains with Microscopes

By W. F. McCULLOCH
School of Forestry Oregon State College

FORESTRY is a long time proposition. The lumbering industry a hundred years hence will depend upon forests which are started this year When agricultural crops prove unsuited to a region they can be changed the next year, but by the time forest crops are found to be unsuited to a region many, perhaps costly, years have elapsed Therefore, the forester must exert every effort to determine that his forests will as nearly as can be foretold, successfully come to maturity Careful calculations may be upset by accidents such as fires and insect epidemics, but climate is the chief controlling factor in the establishment and survival of forests To assure some certainty of success in forest management it is therefore necessary to have some certainty of the kind of climate the forest must endure in the next hundred years This may seem impossible, but weather is known to run in cycles, and if you know the weather of the past you can calculate that of the future with fair accuracy

There are two methods of determining general weather conditions over periods of hundreds or even thousands of years First, analysis of tree rings, a process which can predict weather cycles down to intervals of even a few years, second, pollen analysis, which deals with weather in cycles of centuries

The first method is relatively well-known, and much information has been accumulated through correlating climatic variations with width of annual growth rings in trees Periodicity of wet and dry weather has been established and, in conjunction with local weather bureau records, it can be discovered that either a wet or dry cycle is commencing The first few years are critical in the life of forest plantations, and absence of moisture is most often the fatal factor In forest planting, especially, short-range determination of the weather cycle is an invaluable aid because it is possible to choose years at the beginning of a wet cycle and plant accordingly

The second method of long range forecasting, pollen analysis, is still new, relatively unknown, and not as well substantiated as tree-ring analysis However, it does hold promise of adding to our knowledge of changing climatic conditions and it does have significance in forestry It is obviously more intelligent to handle existing forests so that they will perpetuate themselves than it is to clear off forests in the lumbering process and then start from scratch with seedlings From the long-range standpoint foresters wish to know whether or not forest species will maintain themselves naturally or whether they will die out under natural conditions, necessitating replacement with different species Information on the possibilities of continued growth of a species in a given region may be calculated by determining whether its pollen is increasing or decreasing in peat bogs This process of examining peat profiles in bogs to determine their pollen content is now known as pollen analysis Because of the potential value of this kind of investigation it is described here in some detail

Courtesy New York State Museum
A vertical section of varved clay from the bed of a former glacial lake in New York State. One-inch squares at left give scale **These thin, annual, horizontal bands of varying sediment enable the geologist to work out definite dates which, in some cases can be correlated with bog pollen dating**

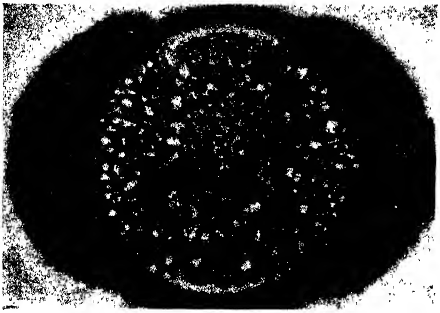
Until lately it was thought that fossils in rock and coal seams were our only record of forests of the past, but recent studies in Europe and in North America have disclosed a fascinating source of material which enables the reconstruction of forest history since the retreat of the glaciers Different plant groups may be identified by their pollen, and the dominance of different types of plants, as shown by the excess of their fossil pollen in peat bogs, indicatea a type of climate known to be hospitable to those plant groups For example, gradual replacement of fir and spruce pollen by hardwood pollen indicates a period of increasing warmth in the long-time weather cycle; indicates also that southern trees may safely be introduced farther north. For those who are able to read them, such peat bog records of our forests are scattered all over the northern part of the continent

THESE records are intimately tied up with the glaciers. As the ice melted and glaciers retreated, forests moved up from the south to take over the newly uncovered lands The ice pack was by no means uniform, and many small depressions were left on the uncovered terrain These low spots filled with water from the melting glacial front, and, with the advance of plant growth, bog formation began

The principal plant in a bog is sphagnum moss As it decays, plant fragments sink to the bottom of the pond gradually filling it. As more and more plant remains sink down, the moss becomes a more or less homogeneous layer of organic material — peat

With no drainage from the bog, the standing water over the peat becomes acidic. The constant addition of decaying organic substance soon raises the acidity to a point where decay organisms are either greatly hampered or cannot function at all. Materials falling into the bog are therefore preserved practically unchanged in the peat. Pollen is one of these materials

It is not uncommon to find lakes covered with a yellow dust in the spring or, at the same time, to find a yellow ring around mud puddles. Upon examination this will prove to be pollen — tree



A winged pollen grain of Austrian pine, magnified approximately 1450 diameters, a probably unexcelled photomicrograph by Dr F P McWhorter, of Oregon State College The reticulations on the surface of the wings afforded identification

pollen, most of it Almost all trees are wind pollinated, they do not have showy flowers to attract bees and hence they depend upon the wind to distribute their pollen This is a somewhat haphazard method. Therefore, in order to assure fertilization of the female flowers, immense quantities of pollen are produced Some of this falls into bogs and, as bog formation continues succeeding layers of pollen are incorporated into successive layers of peat

Peculiarly enough, pollen, though seemingly a fragile substance, possesses an exceptionally durable outer coat This outer coat, or wall, is characteristically marked, sculptured, punctured, crossed with bands or spined like a sea urchin, but in all cases is marked, so that the pollen of grasses are distinguishable from that of flowers, shrubs from trees For this reason it is possible to follow forest history very readily The pollen of forest trees is readily separable down to genera and occasionally even to species

ANALYSIS of a vertical series of samples from pollen-containing peat makes it possible to trace the history of the succession of different kinds of trees composing the neighboring forests from the time when the bog was established Coniferous pollen is mostly equipped with wings, as shown in the illustration, and some investigators have assumed that it will travel farther than the non-winged pollen of non-coniferous species. However, the very fact that forest pollen is so widely transported by wind is adequate assurance that the record will be representative of trees over a wide area, not merely of those adjacent to any given bog. The author has found pollen floating in sea water 75 miles offshore from a forest of Sitka spruce and hemlock, and pollen has been trapped on glass slides exposed on airplane wings at an altitude of 10,000 feet

A very fine correlation has been worked out in Europe between peat bog histories and clay varves, another form of geologic record Clay varves, shown in the other illustration, are the sedimental bands of water-borne silt laid down year after year The coarser material brought down by the spring flood water alternates with bands of finer silt laid down by the quieter water of mid summer, and thus provides an annual record Varves may be counted back about 25,000 years, which is roughly the length of our pollen deposit history Investigators in Europe have discovered for example, that at the geologic period when birch remnants were common in the varves there was an abundance of birch pollen in the peat deposits of the same period Similarly, finding spruce or other conifer twigs and leaves in the varves would be correlated with finding pollen of that species in peat layers of the same age This is the strongest evidence of the authenticity of peat bog history.

The mechanics of pollen analysis are simple Samples of peat from successive layers are obtained by means of a peat sampler This is a short section of pipe equipped with a cap at one end. The cap is attached to a steel rod running through the pipe, and threaded so that any number of rods may be coupled on The sampler is pushed down into the peat to the desired depth, then the rod is pulled up gently, drawing the cap back into the pipe where a spring engages it. The sharpened lower edge of the pipe is thus exposed and, as it is once more pushed down, a core of peat is cut off and retained in the pipe

Separation of pollen grains from the peat may be accomplished by adding chemicals which destroy the peat and leave the pollen grains fairly well intact Another method, used by the author, is to separate the materials with an ordinary milk-shake mixer After thorough agitation the various particles may be separated by adding a water-soluble dye such as safranin This colors the peat pink, and leaves the pollen grains their natural brownish or yellow color, greatly facilitating identification

A drop of peat material is placed on a microscope slide and the grains are tallied in order of occurrence Only a few different kinds appear in the record at one time, and it is not necessary to count a great many at each level in the bog in order to establish a truly representative sample of the pollen present

When samples have been obtained at one-foot intervals down to the bottom of the bog it is fairly easy to reconstruct the history of plant succession in that region The replacement of tree pollen by grass pollen in some bogs, followed again by an abundance of tree pollen, indicates that over a long period there was sufficient change in climate to eliminate trees and replace them with vegetation of prairie like character Return of the trees may be interpreted to mean return of moister weather cycles This is the important phase of pollen analysis to foresters It gives at least an indication of the kind of weather to be expected for the next few hundred years, and therefore an indication of the kinds of forests which may be expected to maintain themselves in the region during that period.

EXAMINATION of a bog north of Syracuse, New York, showed balsam fir and spruce to be the most numerous pollen at the bottom of the bog These two species gradually gave way to beech, oak, and white pine Similar conditions have been found by other investigators working in Ohio and the southern Lake States, in all cases a solidly coniferous forest followed the retreat of the glaciers Hardwoods came in from the south, at first slowly, then in increasing numbers, until they dominated the forest This is the condition existing today Hardwoods grow more rapidly as young trees and, starting from seed, will generally grow fast enough to shade out associated conifers From the evidence of pollen analysis, hardwoods may be expected to be a safe bet for forest production in the northern United States for several hundred years After that time it may be necessary to anticipate return of the conifers Analysis of the pollen profiles that are being laid down in peat bogs today will tell the tale.

WHAT CAUSES MAGNETIC STORMS?

Not Sun-Spots but Gases Erupted from the Sun and Traveling to Earth at Times of Solar Turmoil . . . Sun-Spots May but Need Not Accompany This

By HENRY NORRIS RUSSELL, Ph.D.
Chairman of the Department of Astronomy and Director of the Observatory at Princeton University Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington

MUCH public interest has lately been aroused by the occurrence of "magnetic storms" Along with variations in the Earth's magnetic field (which, by themselves, would have been noticed only by the possessors of delicate recording apparatus), great electric currents flowed through the solid crust of our planet Points a few hundred miles apart were at electric potentials differing by hundreds of volts — which became almost dangerously evident when a continuous telegraph wire joined them The "earth currents" spilled over into telegraph lines and completely disorganized the operation of the intricate — and usually perfectly functioning — automatic recording instruments used in modern telegraph practice. Radio reception was badly disturbed, too, showing that the trouble extended far up into the upper reaches of the air, to the ionized and electrically conducting layers which normally act like a smooth concave reflector, and divert radio waves around the Earth All North America, and communications with Europe, were affected, and, judging by previous experience, the effects were world-wide

The first thing that those who knew anything about the subject asked astronomers was "Where are the sun-spots which are responsible?"

This was no idle question For half a century and more, the Earth's magnetic field has been carefully recorded by automatic apparatus at many stations Great numbers of magnetic storms have been observed — only occasionally as large as those which recently happened — and it has been found, year by year and decade by decade, that their numbers rise and fall in striking parallelism with those of the spots upon the Sun, in a manner which leaves no possible doubt that the two are in some way closely connected What is more, it is usual, at the time of a great magnetic storm, to find a group of sun spots near the center of the Sun's disk — though this is not a rule without exceptions

In the same system of related phenomena belong the great displays of the aurora — the Northern Lights — which extend south from the Arctic regions to the middle latitudes, and, rarely, even into the tropics These are practically always accompanied by pronounced magnetic disturbances, and are related in the same way to sun-spots.

The evidence was convincing, even 40 years ago, that these were all intimately related — not by accident, but by some real causal connection. But the interpretation of this connection still leads to some of the most puzzling problems of cosmical physics.

In the first place — which is cause and which is effect? The luminosity of the aurora and the disturbances of radio transmission occur simultaneously in the same part of the upper atmosphere, and evidently are two sides of the same event But do the currents inside the Earth cause those in the atmosphere, or vice versa? This question can be handled mathematically. If the disturbing magnetic forces which are superposed on the ordinary steady magnetic field, and their changes with time, have been so well observed that we can get a good idea how they changed all over the Earth, an analytical discussion based on principles worked out by Gauss more than a century ago will show whether the currents which produced these forces were inside or outside the Earth's surface (on which the points of observation lay). The answer is definite — the main source of disturbance is outside Hence the currents which flow far above our heads are primary, and those within the Earth are secondary — induced by the others

BUT what is the relation of all this to sun-spots? Common sense suggests that things happening in the thinnest part of the airy envelope of our little planet can hardly be the *causes* of the appearance of spots on the Sun, 93,000,000 miles away, and so large that the Earth could be dropped into the middle of the dark center of one and have a rim around it thousands of miles wide Yet how can these spots affect the Earth?

Cumulative evidence has convinced everyone that the spots are not effective in themselves, but that they serve as a useful — and decidedly accurate — index of the varying general activity of the Sun Near an actively changing spot, the Sun's surface is in turmoil. Bright regions, as well as dark, often appear, and, when these are seen at the edge of the visible hemisphere, eruptive prominences are frequently observed Great masses of gas are raised high above the ordinary level of the chromosphere, and subject to rapid and extraordinary changes The admirable motion pictures obtained by Lyot in France and McMath in Michigan show that the motions are very complicated Often the luminous gas which goes up comes down again, but there are times when great masses of it are evidently driven clean away into space, at huge and increasing velocity

If we follow such a mass of gas — say hydrogen — in imagination, we must conclude that, as it becomes excessively rarefied, it will be ionized — the electrons will cut loose from the protons Such a swarm of electrified particles can no longer give out the familiar spectral lines, and will be invisible But the attraction between the positive and negative charges will keep it from spreading out indefinitely Suppose that such clouds of particles, flying away from the Sun at perhaps a thousand miles per second, should pass the Earth Even a small magnetic field — like that of the Earth 50,000 miles away — has an extraordinary influence on the motions of charged atoms (and much more on electrons). They no longer move in straight lines, but at first in sweeping curves, then, as the magnetic field increases, their tracks become spirals around the lines of magnetic force By the time they are a thousand miles from the Earth, they will be practically coming down these lines of force — though in narrow spirals — and will enter the Earth's upper atmosphere, mainly in the vicinity of the magnetic poles They will naturally set the thin gases shining — as artificially produced streams of electrons do in vacuum tubes — will come on down until their energy is exhausted, and then stop. This accounts in a general way for the properties of the aurora — its appearance in the polar regions and the fact that the luminous clouds or

streamers rarely come lower than 60 miles above the ground, and never lower than 45. Separate patches and streaks in the cloud of particles account for the ever-changing clouds and streamers of an active aurora

It is obvious, too, that the incursion of this swarm of charged particles into the atmosphere will ionize it — affecting radio transmission — and make it more conducting, so that considerable electrical and magnetic effects might follow.

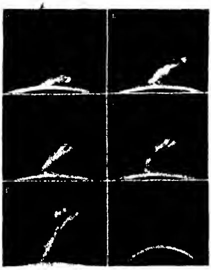
WHEN investigators pass from these qualitative considerations to a detailed attempt to explain the great and apparently erratic changes of field in a typical magnetic storm, the thing becomes very complicated, and no satisfactory detailed solution has yet been reached. The elementary theory indicates that the region where most of the particles come down should be but a couple of hundred miles from the magnetic pole, instead of 1500 as it is The system of currents which produce the magnetic storm may account for this, but no one knows quite how It is also not easy to see how a swarm of particles which has come 90,000,000 miles can contain denser patches as sharply defined as would be required to produce the narrow straight rays which so often appear in the aurora. But this seems to be no reason for giving up an explanation which is so satisfactory on general lines

The regions of eruption on the Sun, from which the clouds are ejected, are usually, but not always, connected with spots — which explains without difficulty why the same is true of magnetic storms and aurorae on Earth An additional effect, of a different type, has recently been well established. At various times, brilliant eruptions have been seen upon the Sun's surface, usually near spots. Far the brightest of all is one recorded by Carrington in 1859. He was making his daily drawing of the sun-spots visible on the disk when two patches of intensely white light suddenly broke out in the vicinity of a large spot group. Within a minute this had begun to fade, and a few minutes later they had vanished entirely.

Up to the present, no similar eruption, bright enough to be seen in integrated sunlight, has yet been recorded, but there are plenty of them which can be observed with the light of a suitable spectral line — preferably the red line of hydrogen

In 1935 Dellinger pointed out that high-frequency wireless transmission had exhibited several sudden "fade-outs," involving great areas, but always on the sunlit side of the Earth, and suggested that they might be connected with solar eruptions. By good fortune, spectroheliograms had been taken at various observatories at the very times that some of these fade-outs occurred, and these showed that eruptions had actually happened.

On April 8, 1936 a very brilliant eruption was independently observed at Mount Wilson and in Peru, and disturbances in the ionosphere and the Earth's magnetic field were recorded at the same moment. This crucial observa-



A series of six spectroheliograms covering a period of 75 minutes and showing some of the extraordinary changes seen in eruptive prominences as mentioned by the author. The six views are frames from a continuity of about 500, made by McMath and Sawyer with the new tower telescope at the Lake Angelus station of the University of Michigan The prominence lifts slowly at first, accelerates rapidly, reaches 500,000 miles above the Sun in frame E, then rushes into space at an exceedingly high velocity. In the Lyot coronagraph films one observes similar action—the prominence seems fairly to slip off into space and vanish in apparent nothingness The effect on the viewer is one of awe

tion has been confirmed on various subsequent occasions, and there is no doubt that these bright solar eruptions are accompanied by fade-outs in short-wave wireless signals, and by certain small but definite magnetic disturbances — quite unlike those of an ordinary magnetic storm

Since these phenomena occur at the very moment the eruption is seen, they must be produced by something which has traveled from the Sun to the Earth with the velocity of light — that is, by some kind of light itself. Visible light would not affect the upper atmosphere perceptibly; but a burst of ultra-violet light, of wavelength too short to get down through the air to the Earth's surface, would by that very token do something in the upper regions where it was absorbed. The changes which affect radio transmission take place in the D layer of the ionosphere, at an elevation of about 60 miles. Very short-wave light, like the strongest line of helium at λ584, would be absorbed by the upper layers, and not get down so far. But the great hydrogen line at 1215 — which is undoubtedly enormously the strongest line in its spectrum — would penetrate to about the right depth, and, when finally absorbed, increase the ionization

KNOWLEDGE of the spectra of these eruptions is therefore important, but it is hard to come by Richardson and Minkowski — who have made successful observations at Mount Wilson—say. "The observer is in a position somewhat similar to that of a man trying to photograph the corona without knowing when an eclipse will occur"

He must watch continuously, and have his instruments ready for instant use

Working with the smaller tower telescope, these devoted observers watched the Sun visually with a spectro-helioscope, and, when an eruption occurred, had everything in readiness to photograph the spectrum instantly, on motion picture film, or, for the infra-red, on plates loaded in a special magazine Between July and December, 1938, close to the time of sun-spot maximum, they recorded numerous small eruptions, but only five of the higher grades of intensity 2 and 3

The visible hydrogen lines show bright in these eruptions, and are the most conspicuous feature of the spectrum The calcium lines H and K which are bright anyhow near sun-spots, appear in the eruptions, and in one specially bright eruption the infra-red line of helium, at 10830, showed bright.

This indicates clearly that these eruptions are primarily regions of strong emission from hydrogen, with probably helium too in the stronger ones Now, by the very nature of hydrogen, an atom which has emitted one of the visible lines will go on to emit the great ultra-violet line Could we get outside our atmosphere and photograph with this line, there is no doubt that the eruptions would appear as enormously bright spots on the surface of the Sun — which shines feebly in these short wave lengths Working, as we do, at the enormous disadvantage of having to observe with the relatively weak lines in the visible region, we must catch only the greatest eruptions, which give ou[r] such a flood of ultra-violet light tha[t] they influence our atmosphere, far away

Light of this intense hydrogen line i[s] very powerfully absorbed by hydrogen atoms, and hence exerts a strong radia[tion] pressure upon them. It is fairl[y] probable that the pressure of radiation from ultra-violet bright spots, not [as] notable on the major eruptions, bear[s] a large part in driving the eruptiv[e] prominences away from the Sun

TANTALUM—NEW OLD METAL

Unsurpassed in Many Uses, Especially Chemical Equipment . . . Has Passivity of Glass, Strength of Steel . . . Hard Tools Made by Powder Metallurgy

By PHILIP H. SMITH

IF one is acquainted with the latest in chemical plant equipment, in electronic tube construction, or the science of metal-cutting and wire-drawing, tantalum is no mystery. But to many it is just a name From now on, however, it is something to watch as a metal having great practical value

Tantalum is a new, old metal It is old because first noticed about a century and a half ago, although a hundred years had to elapse before it was isolated It is new because it joined the community of commercial metals only 18 years ago, and that's yesterday in metallurgical time In those 18 years, research had to cover a lot of territory Methods had to be devised for producing tantalum on a commercial scale, physical and chemical properties had to be determined, ways and means for manipulation and control had to be perfected, and not until all this was accomplished did a curiosity become a practical tool of production

If you think this a long time in which to get from the unknown to the known, you fail to appreciate the peculiarities of tantalum The metal cannot be extracted from its ores by orthodox smelting or reducing methods A chemical process is required Nor can it be put into useful form by any simple process The pure salts have to be reduced to powdered metal, which is then pressed and sintered in vacuum furnaces When this much has been accomplished, special techniques must be used to weld, roll or draw it

The outstanding properties which recommend tantalum to the commercial world are a remarkable resistance to corrosion and chemical attack, in which quality it surpasses virtually all other metals and alloys, an ability to absorb and retain gases at high temperatures in vacuum, the peculiarity of forming anodic films of unusual stability, and a strength comparable with steel

The first commercial use of tantalum was in battery-charging rectifiers where its film-forming characteristic was capitalized upon Shortly thereafter came anodes, grids, and other parts of electronic tubes Its merit for these latter applications is unquestioned, but its position is challenged continually by less expensive substitutes

Tantalum is having its greatest success in chemical plant equipment Since most organic acids salts, gases, alcohols ketones, aldehydes, and esters leave tantalum unaffected, and the high strength of the metal permits the use of thin walled tubes and sheet, even when high pressures are to be used in processes, the chemical industry now has a material which couples the passivity of glass or ceramics with the strength of steel Tantalum, therefore, is coming to be used in heat transfer equipment and in acid manufacture and recovery systems.

Many chemical processes use reagents which are extremely corrosive to almost all metals Glass, ceramics and sometimes plastics can usually be used for kettles, tanks or piping, but since these are poor conductors of heat, some other material must be used to get heat into or out of the corrosive fluids For heating, cooling, and condensing operations, tantalum is not only inert to chemical attack, but each square foot of the metal will transmit as much heat as 15 or more square feet of the container material, or anything else which could be used

COMPACT, highly efficient, hydrochloric acid absorption systems, fashioned of tantalum are now replacing older, cumbersome systems The new type does not require an isolated building to house it, because there are no escaping fumes to attack surrounding structures When muriatic acid is produced as a by-product of a chlorinating process, full recovery of the acid can be had and this by-product made to yield a profit In view of the ever-increasing importance of the chlorine compounds to the chemical industry, the use of tantalum equipment is certain to expand

Before tantalum's inertness to acids could be given the practical twist there had to be long research into problems of fabrication. This could not be done overnight Heating and condensing units require the material in tube form and tantalum could be neither drawn nor welded at the outset When drawn through steel dies it tended to seize to the steel and lubricants were ineffective Now tantalum, in carbide form, used as a die material serves the purpose

The welding point of tantalum is about 6000 degrees Fahrenheit If it is heated in air, it will burn at 2000 degrees Fahrenheit To make welding practical required a method whereby the metal could be protected while undergoing the process Furthermore, if the corrosion-resistant property of tantalum was to remain unimpaired, the welding union had to be made without solder Today, tantalum can be welded to itself and to a number of other metals by electric spot, seam, butt and roller processes, but not by torch welding The operation is carried on under a liquid surface, with special techniques devised for both seam and arc welding

The early days of radio gave tantalum a commercial momentum Battery radio sets demanded rectifiers for the conversion of alternating current into direct current for charging batteries Here, tantalum serves particularly well because of its unique electrolytic "valve" properties When tantalum is used in an electrolytic cell with a dissimilar metal, such as lead, the flow of current forms a stable oxide film upon the surface of the tantalum This film conducts current freely from the electrolyte to the tantalum, but not in the opposite direction,

Tubes of tantalum in absorption tower resist corrosive action of acid

hence converting an alternating current into a direct one Rectifiers employing tantalum are used in railway signal service, telephone switchboards, and fire alarm systems

It is told that perfecting the tantalum rectifier came about through a fluke When experimenting with a number of cells to determine why it was that current flow fluctuated so violently, one cell displayed the desired evenness There was no scientific explanation for this until it was discovered that a tack had dropped into the electrolyte, and thus the addition of an impurity—iron—provided the stabilizing medium which put tantalum into the foreground Even today, signal maintainers, when cleaning a tantalum rectifier cell, sometimes dissolve a few nails in the electrolyte

Tantalum electrolytic condensers are the most highly efficient made, and the fact that they are self healing puts them further in a class by themselves When first made it was practice to take a sheet of pure tantalum, shot blast it to increase surface area and then crumple it into condensed form Present method uses

Photos Fansteel Metallurgical Corp

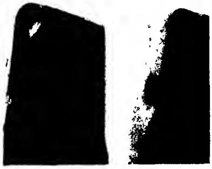
Porous tantalum elements for electrolytic condensers are "self-healing" If the condenser is broken down by over-voltage, film re-forms

the art of powder metallurgy in that powdered tantalum is compressed into a porous element This gives a capacity per gram five times that of its predecessor. Furthermore, if the element is punctured by a high voltage, such as a stroke of lightning, it heals itself and goes on working The porous type is cheaper to produce because manufacture begins with the powder and thereby skips ingot and sheet stages of production It is suggested that the greatest use for these elements will be found in the communications field, but they can be employed in many others

Thus far tantalum has been considered as a pure element, but the contribution to industry is by no means limited to the metal in this state Tantalum carbide, a sintered product, and tantung, a cast one, are both serving the metal-forming industries, but just what they are and why they are being used for tools, dies, and wear-resistant parts requires going back a moment for auxiliary information.

Some Uses of Tantalum, its Alloys, Oxides, and Combinations

Electronic Tube Elements
Dies, Tools, Tubes, Rods
Rectifiers
Chemical Equipment
Acid Absorption Systems
Welding Rods
Electrolytic Condensers
Agitators, Spinnerets



Edges of cutting tools Use forms a crater on tungsten carbide tool at left, not on tantalum carbide, right

Broadly speaking, there are three classifications of metal-forming tools Arranged in an ascending scale of red hardness, these groups are

High speed steels
Cobalt-chromium tungsten combinations.
Cemented carbides

There are many varieties within each group and years of experience have pretty much fitted the tool to the job When cemented carbides came on the market, tungsten carbide was hailed as an ideal tool for cutting steel, but it failed in its promise It was extremely hard and would cut at high speeds, but it suffered from the phenomenon of cratering, or the tendency for a tool to wear away where the chip strikes as it leaves the cutting edge

Tantalum carbide displays a marked resistance to cratering and when added to the other refractory carbides produced the first really suitable tool for machining steel Tantalum carbide has a wetting or self-lubricating property which presumably explains its achievement

Tantung is an alloy consisting of fine particles of tungsten and tantalum carbides imbedded in a matrix of chromium and cobalt, and is distinguished from carbide compositions by being cast rather than sintered It lacks the ultra hardness of the carbide group, but is tougher, hence it fills a rather wide gap between the cobalt-chromium-tungsten group and the carbides.

The role selected for this new material to play is the cutting of steel, particularly for interrupted operations where a certain amount of shock must be taken and which would be likely to break down the more brittle carbides In actual cutting operations it can take larger bites because of its toughness, but not at as high speeds as the carbides

The fact that tantung is cast rather than sintered is significant It suggests that tantung is more easily handled than carbides, and this is true in some particulars The sintered carbides must be formed in soft state and then hardened to unalterable form, tantung can be given other shapes by welding The extreme hardness, characteristic of carbides, can be imparted to surfaces to make them highly wear-resistant, by the simple expedient of laying down a tantung deposit with a welding torch Thus, an almost unlimited field of usefulness is opened

TANTALUM carbide is used in dies for much the same reason that it goes into cutting tools Its hardness and wetting properties in the form of carbides give it special value Tantung enters into die construction because it displays a great resistance to deformation under heat It is used for large size dies, for heading and sizing dies, for certain extrusion types, and in general wherever high pressures and shock must be stood

Tantalum is a high strength metal, otherwise it would be impossible for tubes of it having walls no thicker than 15 to 20 thousandths of an inch to withstand pressures as great as 150 pounds per square inch Since chemical attack does not occur under conditions where tantalum is recommended, it is unnecessary to provide for loss of metal due to corrosion, as is commonly done when base metals are used Therefore, thin walled tubes are safe at high pressures

Strength and non-corrosive properties put tantalum into many applications Thus we find agitators in mixing equipment being given tantalum-covered steel shafts and solid tantalum blades; aerators which have tubes and jets of the metal, and tantalum protected pump shafts and valves Spinning jets used in viscose process rayon manufacture have been made of tantalum, but these are used principally in countries where the shortage of precious metals offsets the low scrap recovery value of tantalum

Just what territory tantalum may next pre-empt is any man's guess Those who have worked most closely with it are loath to make predictions It takes long and painstaking research to prepare the ground for small advance and there's still much to learn about this unusual metal. One can guess that whatever is new will utilize the unique properties already employed and which are not duplicated in any other metal or alloy. This would give tantalum more value and prominence in the industrial scheme

What Is Death?

Science May Know When it Learns What Life Is . . . No Surgeon Ever Brought a Dead Patient Back to Life . . . We Do Not Die All Over, All at Once

By BARCLAY MOON NEWMAN

AFTER he is dead, can a man be brought back to life? Can a man die twice?

On an operating table lies a patient, already asleep under the influence of the anesthetic. A most delicate operation is imperative, to save the man's life, though he has been weakened seriously by a long illness A slowly but steadily growing tumor has for months been exerting pressure on his brain

It is dangerous to use the knife on so weak a patient Yet it is dangerous to postpone the operation The cancerous growth must be removed by surgery Otherwise the tumor will in a few weeks be pressing on vital centers in the brain, and then suddenly the man will die

The surgeon gets busy with his gleaming scalpel The patient's pulse is under constant observation It is very weak Gradually it becomes still weaker. The anesthetic and the shock of the surgical knife prove too much for the strained heart The nurse taking the patient's pulse warns the surgeon Then, all at once, the heart-throbbing flutters out entirely. Instantly, the surgeon halts his cutting, and calls for the hypodermic needle kept ready at hand for just this emergency.

The hypodermic contains a solution of that most powerful stimulant, adrenalin Calmly the surgeon takes the needle from the nurse finds the proper point immediately over the heart, and firmly presses the needle through the skin and tissue -- straight through and into the very heart muscle, now completely still Adrenalin solution is injected into the heart tissue The patient's heart has not been beating for several seconds

ONLY a few years ago, before the discovery of the use of adrenalin, the man would have been pronounced dead

But the adrenalin accomplishes a seeming miracle Almost immediately after the injection, the apparently dead heart commences to throb again — very faintly, almost imperceptibly at first Then the pulse becomes stronger and stronger Amazingly, the normal heart beat is restored The patient has been snatched from death The surgeon can proceed The removal of the tumor is accomplished successfully The dangerous, almost fatal operation completed the still benumbed patient is carried to his bed His convalescence is necessarily very slow, but he finally makes an uneventful recovery

Now, when the newspapers report such a remarkable life-saving feat, as in this case where adrenalin is used to restore the contractions of a seemingly dead heart, as a rule they say that the surgeon "brings a dead man back to life" Sometimes the patient is interviewed — after he has recovered sufficiently — and asked for his sensations while "dead." Weird sensations may be described, or the patient may say that he felt nothing

What is the truth? Was the patient really dead when his heart ceased to throb? The truth is that no dead man has ever been restored to life. That is, death involves more than a mere, momentary halting of the heart beat In fact, medical records list the cases of several persons who have had the extraordinary power to make the heart stop beating for minutes at a time The individual would, when he voluntarily caused his heart to suspend its action, become unconscious Then, after a brief period, his heart would start beating once more, and his consciousness would return. The most famous of these persons with varying degrees of control over the heart died recently — at an early age, following a severe heart attack which occurred a few days after he had made an astounding demonstration of voluntary heart control before a gathering of physicians

Nerve cells of an infant dying at birth and of a man whose death was attributed to "old age" Loading up with granules may kill the cells

Hence it is evident that death is more than temporary stoppage of the heart's contractions In the case of the patient whose heart fails during an operation only to have heart activity restored by adrenalin, the life-giving flow of blood pauses for only a very few seconds. When the heart starts beating again, immediately fresh blood, carrying the needed food and oxygen, courses through the arteries and other blood vessels of all the tissues, especially the most delicate tissues, those of the brain. The microscopic units, or cells, have merely been forced to reduce their vital activity to a minimum Few, if any, tiny cells perish at such a time, even in the brain

NOR are the patient's heart cells dead They are merely somewhat less active than usual, their functioning reduced by want of nutrients and oxygen, by accumulating wastes, and by badly working nerve centers of control. They are alive, but not active enough—having insufficient food and oxygen—to make the powerful contractions necessary to the beating of the heart As soon as they receive a sharp stimulus, they contract, make the blood recommence flowing, and thus supply themselves and the other tissues with required substances, so that quite active life can be maintained

If the blood supply is cut off for more than a very few minutes, many of the microscopic units, or cells, of the tissues actually die And if even small portions of vital tissues are killed, they drag the remainder of the body down into the abysm of true death, from which there is no escape—and never has been.

Brain cells are most rapidly killed. Other cells, after the supply of needed materials is shut off, die less speedily. Cells of internal organs, such as the liver or kidneys, may stay alive for hours, sometimes even for weeks Cells of the intestine seem to be most hardy, and have been found alive more than two weeks following the death of the rest of the body

Bodies, then, do not "die all over, all at once" In the light of this fact, what is death? Though the meaning of the term death is, strictly speaking, never altogether definite or clear, every day thousands of individuals are pronounced legally dead—and quite rightly so—because the heart beat cannot be restored after a reasonable elapse of time, and breathing also has evidently been halted without any chance of being restored. Further, of course, the body's tissues

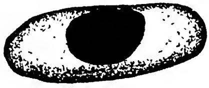
within a few hours become completely cold, and stiff—as rigor mortis sets in.

Nevertheless, days after an individual is legally dead—and perhaps buried—fragments of the inner organs could be found fully alive The tiny hairs in the windpipe which sweep dust particles upward and away from the lungs during life, are frequently found still exhibiting their rhythmical sweeping motion — their rhythmic beating This proves that the tissues inside the windpipe are still alive. Then, they in their turn perish

Such living portions of dead bodies may be cut out and placed in glass flasks containing solutions of food and oxygen Kept warm, and in the midst of this food and oxygen, and with contamination by microbes carefully prevented, these bits of tissues may be kept alive in the laboratory indefinitely Moreover, at the Rockefeller Institute, methods of stimulating these living fragments have recently been discovered, and as a result these bits of tissue can be made to grow Yet the growth is aimless, and never results in the production of a whole new organ or even anything more than a still microscopic piece of formless tissue It would be possible for a wealthy man to provide for the keeping alive of whole sections of his body, following his death ("legal death")—though these sections would have to be kept alive as numerous separate and very tiny bits, each in an individual flask holding food and supplied with oxygen Such test tube life, it is thought, can be maintained indefinitely — probably for centuries — provided it is suitably cared for by continually supplying fresh nutrients and fresh oxygen, and transferring the bits of tissue to fresh flasks once or twice a week

TISSUES of cold-blooded creatures, such as frogs, salamanders and especially very low forms of life—for example, many kinds of worms—are far more hardy than those of warm-blooded animals, such as mammals and birds In the 18th Century, a biologist named Baker obtained some threadworms—microscopic worms having a threadlike appearance—after learning that these worms had been kept quite dry and seemingly quite lifeless for 27 years. After they were soaked in water, they began to revive, and soon were swimming actively in the water. This experiment is said to hold the record for suspended animation among animals Plant seeds, however, may be kept even longer in a state of suspended activity, and then made to sprout when planted Spores of molds and bacteria are believed capable of indefinite existence in dry, cool places—perhaps for thousands of years, though experiments showing the presence of living spores sealed for thousands of years, if not millions of years, in lumps of coal, are not generally accepted by a majority of conservative scientists.

There is no scientific test for death. Indeed, the most expert life scientist cannot tell whether a dry seed is dead or merely dormant until he has observed the seed over a lengthy period to see whether moisture and warmth cause the seed to start sprouting Thousands of scientists through the centuries have sought for a simple test for death. Today it is commonly believed by biologists and medical experimenters that there never will be a simple death test—at any rate, not until that far-off day when the secret of life is discovered. For, death is merely the stopping of the life processes, many of which escape notice and all of which are utterly mysterious



Conditions under which death occurs differ widely for different types of living things. ***Above.*** **A spore of a lower plant and,** ***below,*** **three kinds of bacteria. These may be cooled to absolute zero (459.69 degrees below zero on the familiar Fahrenheit scale), yet death may not occur Numerous other simple organisms are "tougher" than humans which are not tough at all**

Since there is no death test, frequently errors are made in the attempt to determine whether or not a person is dead The heart action and the breathing may be so faint as to elude all efforts at detection, and meanwhile the body may grow fairly cold. Evidences there are aplenty that individuals pronounced dead have been buried alive by mistake Thus, tombs have been opened and found disturbed within, just as though the buried person had regained consciousness and struggled to free himself. And of course at least some of the stories of a "dead" man suddenly sitting bolt upright on the undertaker's table are true

Nevertheless, though there is no simple scientific test for death, scientists are quite certain that after the heart has definitely ceased beating during more than 10 or 15 minutes, a human being is dead beyond the shadow of a doubt The problem is, however, to be sure that the heart has actually ceased its throbbing.

In cases where a person is nearly drowned, and is revived only after perhaps an hour of artificial respiration, the heart cannot have halted completely for more than a very few minutes, if it has halted at all Very faint heart action can proceed without ready detection. Should the heart have stopped for a full ten minutes, resuscitation means that the individual is revived in spite of the definite and irrevocable death of many cells of the fragile brain—and the individual is thereafter demented, though he may live out his normal span of life

RECENT experiments with dogs support this view One scientist, Winkelbauer, bled dogs until the most refined electrical tests showed that the pumping action of the heart must have been completely stopped If he waited not more than five or six minutes, and then quickly returned the blood to the animal by transfusion, a few of the dogs would recover If he waited even two or three minutes longer, practically none of the animals could be resuscitated—though occasionally a dog could be brought back to life after as long as 20 minutes. (By "bringing back to life" is meant restoration of the full activity of cells whose activity has been brought to a low point by lack of oxygen—but whose activity has definitely not been terminated, even for a moment, by actual death.)

In instances where electrical recordings have been taken of the failing heart action of dying men, it has been found that electrical signs of a slight pumping action may persist for sometimes 20 minutes after respiration has seemingly been completely stopped and after the pulse has completely disappeared. Ordinarily, these dying men would be pronounced dead a quarter of an hour or more before true death of vital centers of the body!

In view of such findings, it is evident that many a drowning person may have slight heart action, though breathing has been stopped and the pulse has disappeared Clearly, the person is not dead. But not only in cases of drowning but also in all other cases, when the heart's pumping has been stopped completely—brought to a dead standstill—then, usually after five to ten minutes and certainly after 20 minutes, all hope of resuscitation is gone For, after these few minutes of lack of oxygen and nutrients, whole areas of the brain cease all life activity—that is, perish. And once dead, a cell or a tissue or an organ is "dead all over," and dead beyond recall

A dead man cannot be restored to life A human being cannot die twice.

It is clear that a knowledge of what death is must await the discovery of the secret of life. Meanwhile, scientists, while zealously hunting the mystery of life, must define death as the opposite of life—the absence of that world of activities which means life.

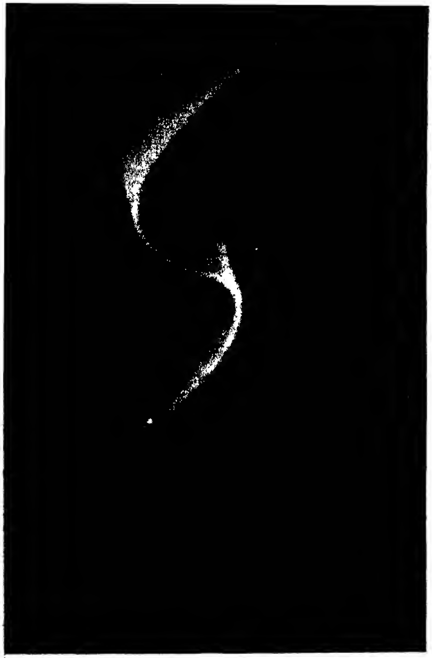


Figure 1 Left An aurora of the S-curved curtain type, observed in Illinois in March *Figure 2. Above* Coronal type of aurora observed at Bar Harbor, Maine, in August

MARVELS OF

By WILLIAM CROWDER
Illustrations by the Author

SPECTACLES of such transcendent beauty as the aurora polaris, the parselenic rings and arcs surrounding the Moon, and the zodiacal light, are beheld more frequently in North American skies than is commonly believed

Contrary to a widespread belief, the aurora may occur at any season of the year, not merely in winter The phenomenon referred to in the northern hemisphere as the aurora borealis is the same thing which is called the aurora australis in the southern hemisphere, the term aurora polaris, or simply aurora, applies in general to both

There are several type-forms of the aurora, a common type being the exquisitely colored, tenuous, folded curtain form shown in Figure 1 and in the upper portion of Figure 5 The commonest form of all, however, is the arch, shown in the lower part of Figure 5 The arch may be without color, a pearly kind of light, but more often it exhibits several delicate prismatic colors. At times it may become truly gorgeous Though the position of the arch itself may remain comparatively fixed, its parts may pulsate Sometimes it may send upward needle-like streamers varying in length and brilliancy

More rare is the coronal type of aurora (Figure 2), conceded by most observers to be the most impressive of all auroral forms It is seen almost invariably at or near the zenith, and it presents the aspect of numerous fanlike rays emanating from a common center

When color is present in the different auroral forms, it is most usually apple-green Although nearly all colors may be seen, those next in frequency are rose, red, lavender, violet and deep purple

Discoveries about the northern lights have completely

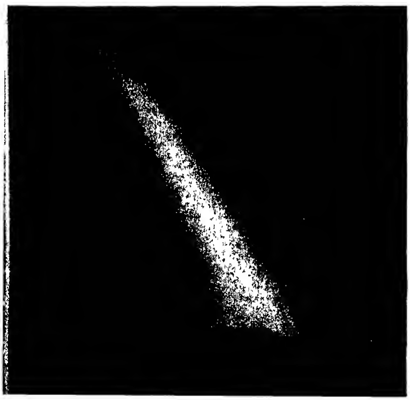


Figure 4 Left The zodiacal light as observed in August, 1939, from Mexico Cause, astronomical

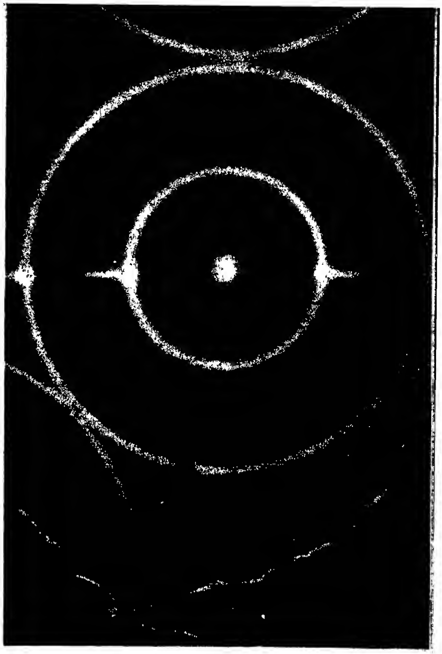


Figure 3 Right· Moon, lunar halos and parselenae. Cause, refraction and reflection in ice crystals in the air (explanation is given in Humphreys' "Physics of the Air")

THE NIGHT

Striking Natural Phenomena . . . The Aurora, Zodiacal Light, and Bizarre Types of Lunar Halos

changed previous concepts of these once mystifying spectacles, and several theories have been offered as a consequence One theory supposes that the auroral light is produced by the bombardment of the molecules of rarefied gases in the upper atmosphere by the ultra-violet rays of the Sun These rays knock the electrons from the atoms to which they belong, in short, the gases are ionized. These multilated molecules then move toward the Earth, where they are attracted along the magnetic lines of force and produce the effect we know as auroral light Another theory differs only in that tiny electrified particles are violently projected directly from the Sun These are attracted spirally along the magnetic lines of force toward the magnetic poles of the Earth

The least height at which the aurora borealis has been recorded is 45 miles, the greatest height being some 600 miles The greatest number occur near the lowest level. The distances of auroral forms from the observer, and their heights above the Earth, have been computed with exactness Especially designed cameras equipped with wide-aperture lenses and using rapid emulsion films are utilized for this purpose Simultaneously from several stations, sometimes from 20 to 50 miles or more apart, the exposures are made on the same auroral feature. These exposures are synchronized by means of telephonic communication between the operators, who wear headsets. The resultant negatives are so marked that they may be compared with one another The position of each camera with reference to the aurora

Figure 5: Right. Aurora, arch type with vertical streamers, curtain type above it. Seen from Iowa

and the background of the stars always shows a parallax, or shifting; the measured distance between two stations is the base line. In this way are secured two angles and the included side of a triangle. The rest is merely mathematical—the ordinary process of triangulation.

The latitude of maximum occurrence of the aurora borealis is not, as once was believed, at the region of the Earth's geographic Pole. The occurrence of greatest frequency is near the region of the magnetic pole, which is many degrees south of the North Pole, near the Arctic Circle in northern Canada.

On any clear, moonless night in the year the possibility is by no means remote that the observer may be the fortunate witness of a spectacle which, of all celestial thrillers, is second only to the total eclipse of the Sun—and this possibility also exists whether he lives in the latitude of Maine or that of southern Florida.

Another striking nocturnal marvel in no way related to the aurora is the phenomenon of lunar halo (Figure 3) to which similar solar halos are related because of identical cause—the refraction and reflection of light in tiny snowflakes or in needles of ice, most often when the clouds are low or when clear air contains the needles. The majesty and loveliness of either a lunar or solar halo and its secondary images are as inadequately describable as that of the aurora, with which they easily rank in beauty. It is now believed that the celebrated cross which Emperor Constantine perceived in the sky, about A.D. 313, and which persuaded his conversion from paganism, may have been part of a system of solar halos, two of which at right angles would form a cross.

IN the common form of fully developed lunar halo, two concentric circles are produced, with the Moon at the center, the inner halo having a radius of about 22 degrees, and the outer halo about 46 degrees. Passing horizontally through the Moon and through both halos is a track of light, the paraselenic circle, of about the width of the Moon's diameter. On this horizontal track usually appear a number of secondary lunar images, the parselenae, the most brilliant of which are the two located near the intersections of the inner halo. The parselenae are brightest when the Moon is near the horizon. As the Moon rises, they move somewhat beyond the halos and assume flamboyant tails which are directed away from the Moon. All the colors of the spectrum are delicately exhibited in the halo, owing to the optical phenomenon of interference, however, the only decided tint is red, and this color is invariably located on the inner side of the rings. A parselena, being itself a secondary source of light, often very brilliant, may in turn have its own encircling rings, not included in the drawing. These secondary halos, however, are much fainter than the primary ones. In addition, there may be a magnificent circumzenithal arc touching the outer halo at its upper point, together with brightly colored tangential arcs touching the lower half of the outer halo. These, too, can be explained as refraction and reflection from the frozen crystals. Not all the details described may always appear in full and perfect form in any given display. Indeed, ideal perfection here is rather rare.

Water crystallizes in the form of regular hexagonal prisms, usually with plane ends but sometimes with hexagonal pyramids as terminals. Now, if we consider any two non-parallel faces of one of these crystals, it is clear that their combination must act as a prism, decomposing white light, which passes through them, into its constituent colors. The refractive index of ice, however, is such that no ray of light can pass through a prism of it having angles greater than about 99½ degrees. Therefore, the power to create the halo effect must be limited to pairs of faces whose inclinations are inferior to this. In the present instance, that would mean the alternate faces of the prism where the inclination is 60 degrees, and a face with a terminal plane whose angle is 90 degrees. Every such crystal, then, suspended somewhere near the line joining the eye and the Moon, must send to the former some definitely colored ray from each effective pair of surfaces. With the prisms having their axes in every possible direction, it is evident that the appearances produced must be symmetrical, and must therefore consist of circles around the luminary.

Taking now the inner halo, its appearance may be explained by supposing the colorless portion to consist in part of the recombination into white light of its multitudinously separated elements by minute prisms, and also in part from the following cause. If a prism, through which a ray of light is passing, be turned gradually on its axis, the refracted ray also turns, but at a gradually slower rate, to a point called minimum deviation, from which point it will retrograde increasingly faster. Hence as we have assumed the suspended prisms in the atmosphere to be in all possible positions, those near the position of minimum deviation will contrive to refract light in the same direction, and their effects will be consolidated. All the others will cause a dispersion of light. As the red rays are the ones that lie near the point of minimum deviation, there is consequently a red circle around the Moon with an angular radius of 20 degrees, 50 seconds, the angular radius of minimum deviation. Inside this circle there will be no light; outside, the light will be somewhat colorless and feeble.

The explanation and appearance of the 46-degree halo are the same as for the halo of 22 degrees, except that its position depends on the right-angled prisms formed in the hexagonal prism.

Less spectacular perhaps than the other phenomena described, but none the less mysteriously impressive, is that marvel of the night which manifests itself as a strangely elusive ethereal glow, concentrated along the zodiac — the broad path in the sky along which the Sun, Moon, and planets appear to move — and which consequently is called the zodiacal light (Figure 4).

The zodiacal light, like the aurora, can be seen only on a moonless night. After the last vestige of twilight has vanished in the west, this phenomenon often appears in spring like a tenuous, luminous mantle of mist through which the stars seem to twinkle with almost undiminished brilliance. In autumn it is best seen in the east shortly before the first hint of dawn. Although not infrequently observed from higher latitudes, it is better and more often viewed from clear, arid regions in the tropics, where its subtle golden drapery adds more than another touch of mystery to the night.

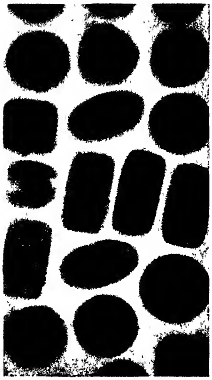
THE physicist has determined that the nature of this light is similar to sunshine. This discovery leads to the conclusion that the zodiacal light is in reality reflected light of the Sun coming from billions of minute meteoric particles moving in orbits of their own around the sun, and extending at least as far out as the Earth's orbit. While we seldom see the complete band of the zodiacal light, it extends all the way around the ecliptic. On it, directly opposite the Sun, is a brighter area, the *gegenschein*, or afterglow, some ten degrees in apparent diameter. In this area each particle may be thought of as at full phase (exactly like the Moon though far smaller), and this accounts for its added brightness.

The rarefied nature of the material in this region would seem at first thought almost incredible. It has been estimated that the small particles reflecting the sunlight are somewhat less than a millimeter in diameter, and are spaced from one another at about an average distance of five miles. Therefore it follows that, if all these tiny bodies, distributed throughout at least nearly 100 million miles of radius, were to be condensed on the surface of the Earth, they would form a layer not exceeding one centimeter in thickness. In truth this material is so tenuous as to have no appreciable effect in retarding the speed of not only the planets, but also of the very tenuous comets that at times travel through its tremendous reaches.

Foods X-Rayed

To Reveal Presence of Foreign Objects, Some Impurities . . . Also Condition of Products, Fruits . . . Fluoroscopic Inspection Widely Used

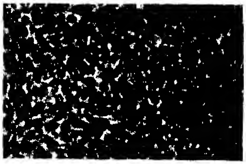
THE average person thinks of the X-ray as a medical tool The technically minded person understands its importance in structural studies in engineering and industry. During the last four years this tool has made another important place for itself, this time in the food industry The processors and packers of many types of food products have developed in recent years screens, sieves, magnetic separators and have applied photoelectric cells to the job of detecting and removing foreign objects from all kinds of foods, but fluoroscopic inspection has proved to be superior to them all in some respects However, the X-ray does more than show presence of impurities In one case, three fluoroscopes, costing a total of $10,000, gave a saving of $60,000, which resulted when a large quantity of oranges which were scheduled for destruction were found to be undamaged by freezing



Right To show how a box of candy gives up its secrets under the fluoroscope, foreign objects were inserted in some of the pieces of candy The objects show up as irregular black spots in several of the candy pieces

Below Radiograph showing oranges as they appear on the viewing screen of a visual inspection X-ray unit Images of even density show an even distribution of juice while the mottled images indicate frost-bitten or crystallized fruit. *Right* Fluoroscopic inspection of lemons

Left A shallow box of shelled peanuts ready for salting. To the eye, it shows no unwanted objects but the X-ray shows presence of many small stones. These show up as in the picture of box at right



Pebbles can be present also in such foods as blueberries, without being seen, *left*. But when passed between the X-ray unit and the fluoroscope, *right*, the berries no longer hide the adulterants

Photos courtesy General Electric Co.

A BIG GUN OF SCIENCE

The Brasch and Lange Apparatus, Old-timer in Splitting the Atomic Nucleus, Faces a Revival with Improvements in Generating Artificial Lightning

By C. W. SHEPPARD

THANKS to the World's Fair and modern advertising, artificial lightning bolts, such as electrical engineers use for testing purposes, have become as familiar to Mr and Mrs American as their living-room rug. The development of any instrument of pure or applied science invariably leads to the subsequent discovery of unsuspected uses for it. In the case of the "impulse generator," as the machine for producing artificial lightning is called, one little-known use was the disintegration of atoms. Before we can understand this use, we must look back a few years.

In the middle 'twenties, a good deal was known about the outside of the atom. The behavior of the electrons, which move in complicated orbits about the central nucleus, was fairly well understood, hence scientists, looking for new fields to explore, were already turning to the atomic nuclei. They were trying to break them open and find out what was inside by shooting fast particles at them. Some success had already been achieved by using the alpha particles that shoot out of the nuclei of radioactive elements with velocities of about 20,000 miles per second; but many kinds of particles which scientists wished to use could not be obtained in this way. One method of reaching high speeds with these particles was to put them into an evacuated tube, where there were no air molecules to slow them down, and then to apply a high voltage. This would accelerate them to the desired velocity. However, the obstacle which held scientists back was the tremendous cost of high-voltage equipment.

IT was here that three pioneers of nuclear physics — Brasch, Lange, and Urban — took the bull by the horns. Between two peaks of the Monte Generoso, in the Swiss alps, they hung a long cable between two enormous chains of insulators. In this region, electrical storms are frequent, and they hoped to pick up enough atmospheric electricity for their purpose, either from direct lightning strokes or from the highly charged air beneath the thunderclouds. This hazardous improvement on Benjamin Franklin bore some fruit. Sparks were measured up to 60 feet in length, representing somewhere between 10,000,000 and 15,000,000 volts. Unfortunately, Urban, while working high in the air on th cable, slipped and fell to his death.

Brasch and Lange continued the work alone, but they soon managed to obtain facilities for making high voltages artificially so they were able to put their umbrellas away and take their work indoors. Instead of a continuous alternating or direct current, as was used by other workers, they investigated the effect of sudden high-voltage impulses or "artificial lightning." These heavy electrical "surges" were produced by an apparatus already well known to electrical engineers and physicists. In this scheme, a bank of electrical condensers is charged in a parallel connection and then discharged in series. Suppose, for example we charge 12 condensers in parallel, with 200,000 volts. If we then connect them in series, the voltage will add up to a resulting voltage of 2,400,000.

A very clever circuit is used to effect this process of parallel charging and series discharging. The bank of condensers is charged in parallel through tubes of glass or rubber filled with water. Unlike a metal wire, water will allow electricity to trickle in, but resists any sudden electrical surge in much the same manner as a pneumatic cylinder controls the closing of a door. As the electricity flows into the condensers, the voltage across them, which is proportional to their charge, likewise increases.

A 2,500,000-volt impulse generator. Discharge takes place along chain of spheres in the center of picture

At a certain critical voltage, a chain of spark gaps between the condensers flashes over and the entire bank of condensers suddenly discharges in series. Since the parallel connection is made through water tubes which will not

The lightning collector, 1½ mile long, used

transmit electrical surges, the sudden discharge is prevented from wrongly taking the original charging oonnection.

When allowed to discharge across an external spark gap, an impulse generator makes a very impressive display. Due to the high current let loose, the discharge appears with a blinding white flash, accompanied by a report which makes the ears ring. If a block of wood is placed across the gap, it is blown into many fragments.

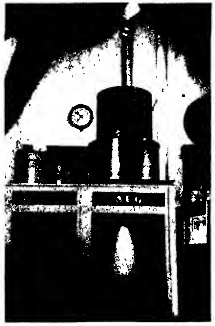
Having obtained the necessary high voltage source, Brasch and Lange next required a vacuum tube through which to shoot their atomic projectiles. For this purpose, they devised an ingenious and simple arrangement. Alternate rings of laminated paper and steel, separated by rubber vacuum gaskets,

were piled one on the other to the required height and vacuum pumps were connected below The tube was usually immersed in a tank of oil for insulation purposes When oil was used, the tube could actually be designed less than knee high if it were to work at 2,500,000 volts Such conveniently compact construction would not be possible unless one were making use of the impulse principle With continuous current, gases would be produced in the laminated paper wall of the tube by the discharge, thus making a vacuum impossible This does not happen in the case of the quick impulses, for, by the time appreciable amounts of gas have formed, the discharge is entirely over and the pumps can clear the tube out before the next discharge occurs

These two trail blazers did considerable pioneer work in atomic bombardment with their "heavy artillery"

in the early experiments at Monte Generoso

Shortly after the first history-making artificial disintegration experiments of the two English physicists, Cockcroft and Walton, at Cambridge, they checked the results with their technique and confirmed them In numerous experiments, they bombarded atoms of many elements, using protons (nuclei of hydrogen atoms) for their projectiles Although the impulse technique produces fair bombarding intensities when using protons, the most spectacular results are obtained with electrons It is true that a high voltage impulse lasts only a few millionths of a second, nevertheless, the current during that interval is at least 1000 amperes. For this reason, if we take a very conservative view, such apparatus, discharging once every second, has an output equal to a continuous cur-



A blast of electrons from the bottom of the tube produces a strong, spectacular luminosity in the air

rent of one thousandth of an ampere or more Measurements show that about one quarter of this can be converted into bombarding electron current The power of bombardment of such a 2,500 000 volt impulse generator, then, would be a little less than one horsepower

This power may not appear to be large but when concentrated into a beam of electrons it produces spectacular effects A thin metallic foil can be placed on one end of the tube so that the vacuum is preserved A small amount of residual gas in the tube becomes ionized by the discharge, liberating large quantities of electrons which shoot through the tube, traverse the thin foil and escape into the air In this manner, beams of electrons can be shot many feet and can be seen as a blue glow in the air If the electrons are allowed to strike a calcite crystal, it will fluoresce, giving forth bright orange light, with the same brilliance as a 40 watt electric lamp Given one impulse, it will glow, or phosphoresce, so strongly that, after one hour or more, one may read by the light which it still emits Although the electrons will traverse the thin metallic window without doing any damage, if they are allowed to strike a thick metallic plate, they will blast out large craters

The impulse technique has been regarded in the past as a spectacular offshoot of physics. Its ability to do good work was questionable in the face of such competition as that offered by the cyclotron and the Van de Graff generator. At present, however, scientists are mulling over the possibilities of a Brasch and Lange tube supplied by a 10,000,000-volt surge generator which it is now quite possible to construct

Let us consider one or two of the things which could be done with such an apparatus It has important biological prospects due to its ability to accelerate electrons In the treatment of tumors by means of X-rays, the biological action of the rays has been thought to be due to the fact that they knock out secondary electrons as they traverse the tissues It is these electrons, and not the X rays, which presumably produce the desired effect Unfortunately, it has heretofore been necessary to go through all the roundabout business of accelerating electrons, bombarding a target, producing X-rays which can penetrate the tissues, and finally liberating other electrons which do the actual work Producing both X-rays and subsequent secondary electrons is a very inefficient process. For this reason, a better way to approach the problem is to have a source of electrons which are fast enough to penetrate the tissues directly This method is also superior because electrons can be focused by the use of electron "lenses," while X-rays cannot be focused by any method which has thus far been discovered by science

PRELIMINARY experiments with a 2,000,000 volt surge generator are at present under way in the high-voltage laboratory of the California Institute of Technology, at Pasadena One object of these experiments is to try the effect of improved methods of making protons, to see whether they can be accelerated in the same large quantity as electrons If this can be done, another important use for the impulse method presents itself In 1933, it was discovered that, by bombarding certain nuclei with atomic particles, a sort of hybrid nucleus could be built up which was unstable and soon broke down in much the same way as do the nuclei of the naturally radioactive elements such as radium This process is called artificial radio activity A use was soon found for this discovery Small quantities of these artificially radioactive substances can be prepared and formed into chemical compounds They may then be put into a living organism and their progress through the organism can be traced by following the course of the radioactivity with electroscopes or other detecting instruments By the use of these biological tracers, much valuable information about the chemical behavior of living things has been obtained The difficulty lies in producing large quantities of these radioactive substances. With sufficiently powerful charging equipment, the impulse generator can be speeded up to obtain several discharges per second With a few hundred amperes of protons at each discharge, the Brasch and Lange tube will be a good source of biological tracers

For Better Roads

Extensive Studies of Present Highways . . . Visibility . . . Grades . . . Curves . . . Traffic Quantity, Quality, Speed . . . Data Aid Future Planning

By THOMAS H. MACDONALD
Commissioner of Public Roads

SINCE the Federal government created the Office of Road Inquiry in 1893 to advise farmers how to build better roads, studies have been made continuously to learn how to build stronger and more durable surfaces. There have been few discoveries that have attracted widespread public notice, but progress has been continuous. Much of the work has been done in laboratories from which there have poured unending streams of small improvements that have completely changed the quality of our road surfaces. For example, the concrete roads built today

Scale mounted in front of steering wheel indicates degree of curvature

have twice the strength of the concrete roads of the same thickness built 15 or 20 years ago The hit-or-miss construction of surfaces with gravel, sand clay, and similar materials has been replaced by use of materials of known quality, and new methods of finishing these surfaces with bituminous materials produce smoothness and riding comfort of the first quality

Within recent years, both the highway program and the field of highway research have been greatly broadened. The end of the pioneer period of road construction has been reached During the pioneer period the main objective was to place a surface of some kind on the network of main highways This job has been completed but the enormous increase in volume of traffic and in the speed of vehicles has brought about the necessity for modernizing many of the roads built in earlier years There is need for surface widening and road straightening to improve sight distances and eliminate sharp curves Grades need to be eased, grade crossings must be eliminated, and many other improvements must be made to bring our highways up to the standards required by modern traffic

Attention can no longer be centered on the main rural highways alone The congestion, delay, and accidents on approaches to cities and on the main routes through them make it imperative that city and suburban improvements be provided without delay At the same time, many secondary roads must be surfaced to connect agricultural areas with main highways

THE problems before highway administrators are complex To aid in their solution the Public Roads Administration is co-operating with 46 state highway departments in conducting highway planning surveys All highways are being mapped and detailed data are being collected on their condition of improvement and the volume and character of traffic over them Studies are being made concerning the source of highway funds and how the funds are used It is intended that these data be used in planning future highway improvements on a scale that will be adequate for future traffic and that the program be conducted on a sound and economic basis

Special studies are being made to derive information to be used in establishing standards for surface width, traffic capacity, and sight distance. There have been many technical discussions of these subjects, but lack of data on the characteristics of vehicles in motion has clouded conclusions. Apparatus now in use is rapidly supplying the needed facts

Efficient management of the 46 state highway planning surveys has required the rapid development of instruments to aid in collecting large quantities of field information quickly and cheaply

A first requirement in the planning surveys was to inventory the existing highways to find where they were deficient in width, in surface type, in alinement, or in any other respect Cars used in the inventory were generally equipped with special odometers reading directly to hundredths of a mile or with "footometers" in which a trailing bicycle wheel records distance in feet on a dial mounted inside the car.

Practically every mile of rural highway has been surveyed for excessive

Somewhat unwieldy but effective is this trailer boom developed in Michigan for measuring degree of curvature. Swing of the boom is registered within the car

grades, and those of 5 percent or more have been located and both the percent of grade and length measured. The varying grades common on hilly secondary roads were measured by approximation only, generally by sighting from the bottom to the top of the grade, using a homemade substitute for a hand level called the "grade board." The uniform grades found on primary roads were measured accurately and directly by a commercial instrument which had been developed for use as an accelerometer This instrument, when mounted in a transverse plane, gave precise determinations of the rates of banking on curves

Measurements of curvature presented somewhat more of a problem The simplest and cheapest device, is designated as a "curvometer" This device consists of a calibrated scale mounted behind the steering wheel Somewhat greater precision was obtained in some states by the unwieldy yet effective trailer or "trailer chord" The boom or chord swings behind the car in traversing a curve, and the amount of swing

Permanent automatic traffic counter installed on a road in Maryland

is shown on a scale calibrated to read directly the degree of curvature.

One or two states adopted the aviator's directional gyroscope to determine curvature. This device, mounted in the front compartment of a car, shows the change of direction in rounding a curve, and the length of curve is shown by a "footometer." The degree of curvature can be calculated from these data.

One of the states most recently undertaking the work of measuring critical highway features has benefited from the work of earlier investigators and has incorporated a "footometer dial," a directional gyroscope, and an altimeter in such relative positions that all may be photographed by a permanently mounted camera at desired intervals, thus obtaining several types of data at the same time.

A means of measuring the distance the highway ahead can be seen, or "sight distance," was developed early in the surveys and has been used almost without change in nearly all the states The problem was to locate and measure the length of all sections of highway with sight distance less than 1000 feet and to determine the shortest sight distance on the section Two cars are required, the front one being equipped with a specially designed stadia rod A rod, mounted on the front of the following car, is of such diameter and at such height as to cover the entire stadia rod when seen by an observer seated normally in the front seat with the two cars separated by 1000 feet

Sight distance is measured by these two cars 1000 feet apart. At that distance, rear car's horizontal rod will cover all checkered spaces on other car's rod

The two cars thus spaced proceed along the road until one disappears from the view of the other The rear car is then at the beginning of a sub standard section By a similar procedure the end of the section is located The difference in readings of the odometer at the beginning and end of the section gives the length

WITH means provided for determining road conditions, the next step was to devise apparatus for use in studying how the roads are used Measurement of the service a highway renders is important in deciding how well it should be improved The permanent type of automatic traffic counter, developed by the Public Roads Administration, has satisfied this need Installed at nearly 500 locations on both primary and secondary roads throughout the entire country, these instruments automatically count vehicles and detect the variation in traffic volume day by day and season by season.

In the housing of each recorder, there are two photoelectric cells, on which light beams, placed on the opposite side of the road, are focused. When both the beams trained on these cells are interrupted by a vehicle, a circuit is energized, closing a relay which, in turn, operates an electric counter The total shown on this counter is automatically recorded by a printing mechanism each hour Both light beams must be interrupted simultaneously to actuate the mechanism. A pedestrian or cyclist, who cuts only one beam at a time, does not actuate the counter.

To supplement these permanently installed expensive machines, various types of portable counters have been developed, some by manufacturers and some by the Public Roads Administration One of these counters is actuated by an electrical contact made in a strip laid across the road for detecting the vehicles Vehicles passing over this strip close a circuit that, in turn, actuates the counter.

Engineers of the Texas highway planning survey have developed a portable counter in which a light beam actuates a photoelectric cell as in the permanent type, but current is obtained from a storage battery This recorder uses a single light beam

In cases where it is not necessary to know the traffic by hours, but only during the time the counter is installed, simple accumulating counters have been developed by the Public Roads Administration In these, the passage of a vehicle actuates a pneumatic switch A small rubber tube is laid across the road As wheels pass over the tube, an air impulse passes through it and moves a diaphragm at its end

In highway planning, there is need to know also the amount and kind of goods moving over highways, the weight of vehicles and their size In the planning surveys, two separate types of weight studies were conducted. In one

Above A strip laid across the road actuates this portable traffic counter. When a car passes over this strip, an electrical contact is made, causing meter at right to register

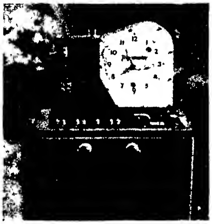
study, large-capacity pit scales were permanently located on a few representative routes in each state, and the weight, height, width, length, wheel base, and capacity determined

An entirely distinct weight study was conducted on all the important roads in 46 states, using a commercial weighing device called a loadometer In these studies, the flow of weight over the highway was desired to determine distances various agricultural commodities and manufactured products are hauled and in what proportion each commodity is found in the normal traffic. Such information is needed in discussing the economics of highway transportation and in determining the part the highway plays in the field of distribution of goods

Special studies are being made to determine the capacities of highways of various widths, the times and distances required for passing maneuvers, and the normal driving practice under various highway conditions The basic equipment used in all such studies by the Administration has been the graphic time recorder Observers stationed at a key at each end of a measured section, close keys to actuate pens and record vehicles entering and leaving the section

Data on vehicle speeds are useful for many purposes including highway design, enactment of legislation controlling speed, safety studies, and enforcement of speed restrictions Observation of a considerable number of vehicles supplies these data Highway capacity information, however, can be developed only from a study of the speeds of all vehicles on sections of highway Field procedures, therefore, had to be developed to meet this requirement

A new method has been developed that involves the use of an extremely ingenious speedmeter This device has as its basic element a rotary stepping switch This switch, similar to those used in automatic telephone switchboards, has a series of 50 points arranged in two tiers around the circumference of a semicircle Each point is connected to one of a series of pens in a graphic-recording unit A wiper arm, pivoted at the center of the semicircle, when energized by a self-interrupting magnet, sweeps over these points, always moving at a constant rate of speed The action of the switch is



somewhat similar to that of a buzzer, but the arm, instead of moving rapidly back and forth between two points, moves ahead from one point to the next

As a vehicle crosses a detector laid across the pavement, a relay is actuated and the switch starts rotating As the vehicle crosses a second detector, generally spaced 24 feet from the first, another relay stops the switch momentarily and energizes the circuit connecting the point on which the wiper arm then rests and its corresponding graphic-recorder pen The point the wiper arm has reached depends on the speed of the vehicle. The slower the vehicle travels the farther around the semi-circle the wiper arm moves before the second relay interrupts its motion By noting the pen that has been thrown and referring to a conversion table the speed may be found immediately

In determining vehicle speed with the speedmeter, other apparatus has been used to record the transverse position of vehicles on the road surface Positions of vehicles on the pavement are influenced by such factors as lane width, pavement strip markings, shoulder type and condition, and roadside objects as well as by the presence and speed of traffic in the opposite direction. Measurements of transverse positions were made with a contact detector laid on the pavement This detector consists of steel strips held apart by a rubber arch similar to that used in refrigerator-door gaskets As the vehicle passes over this detector, the arch is depressed, the strips are brought into contact, and an electrical circuit is closed. One of the metal strips is continuous for the length of the detector and acts as a common lead to all pens of a graphic recorder; the other is broken into 20 sections and an individual lead taken from each section With these 20 sections connected to 20 pens of a graphic recorder, the transverse position of each wheel of a vehicle is recorded automatically

A number of methods have been used to determine the time periods and distances required for vehicles moving at various speeds to pass other vehicles moving in the same direction, but none has been sufficiently inclusive to permit a complete analysis of the movements of all vehicles involved in all types of passings Using graphic time recorders actuated by pneumatic road switches, the Public Roads Administration has

Portable loadometer used to weigh trucks to determine traffic loads

developed apparatus that makes a continuous record of the movements of all vehicles over half-mile sections of highway. Pens in six graphic recorders are connected to pneumatic detectors, each consisting of a rubber tube, covering one traffic lane with a pneumatic switch at its end These detectors are spaced at 50-foot intervals on both sides of the road In actual practice, a single tube is placed across the entire roadway but is plugged at the center line so that each half is an independent unit.

The charts in the machines used in these studies move at 36 inches per minute, to measure speed over the 50-foot section to closer than one mile per hour With this precise speed measurement and an easily-interpreted record of the path of each vehicle, the determination of the exact times, distances, and speeds involved in all types of passing maneuvers is a simple but somewhat laborious procedure These times and distances are essential elements in the establishment of sight distance requirements, but perhaps of more importance are the number and types of passings found in the normal highway traffic The conditions under which passings occur both as to sight distance ahead and position and speed of other vehicles are of great importance in designing safe highways.

Goethe Link Observatory

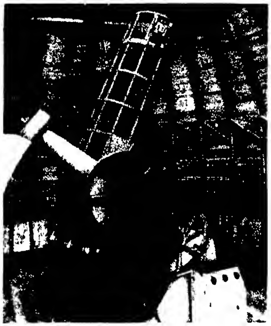
Built, With Its 36-Inch Telescope, by Amateur Astronomers of Indianapolis . . . Financed by Local Enlightenment . . . Presented to Science

By VICTOR E. MAIER

INTEREST in the study of astronomy has mounted with surprising rapidity as an indirect result of the publication, some years ago, of Scientific American's volumes, "Amateur Telescope Making" and "Amateur Telescope Making — Advanced." Comparatively few persons realize the important part these books are playing in connection with the science.

Among the many achievements of the 10,000 amateur astronomers who have made their own telescopes most of them beginning with instruments six inches in aperture, is the new Goethe Link Observatory, at Brooklyn, near Indianapolis, Indiana, with its 36 inch reflecting telescope and five inch auxiliary instrument. This observatory was founded, financed, and permanently endowed by Dr. Goethe Link, an Indianapolis surgeon. The large telescope was built and the observatory erected for the most part by amateur astronomers in the Indianapolis area. Its equipment has been offered free of charge to those who can best use it, especially to the colleges and universities in the vicinity of Indianapolis. Indiana University has supplied a research fellow to work full time at the observatory, which has also been visited by professional astronomers from all over the nation. It is also open to the general public on Sundays.

Right Constructing the massive 30 foot, 200 ton concrete telescope pier



Center The main telescope, constructed by Indianapolis regional talent

Bottom The observatory houses two telescopes, lecture room, workshop

The idea had its start about six years ago when Samuel Waters, president of the Indianapolis Amateur Astronomers' Association, was giving informal lectures to the people of Indianapolis at the backyard site of his home-made telescope. Dr. Link, believing there was enough talent in the community to build a large observatory, set about to finance such an institution and work began.

Carl Turner, a mechanical engineer, of Indianapolis, obtained from the Corning Glass Works a 36-inch ribbed Pyrex mirror disk for Dr. Link. A machine for grinding the mirror disk concave and polishing it was built by Mr. Turner, who also undertook the construction of the mounting for the telescope. The task of finishing, or figuring, the spherical mirror disk to an accurate paraboloidal form was given to Charles Herman and V. E. Maier, both Indianapolis amateur telescope makers. The processes used were similar in principle to those set forth in the book "Amateur Telescope Making," the bible of the hobby, except that the disks of glass used as grinding tools for the main disk, instead of weighing about two pounds as in the case of the average beginner's telescope of six-inch diameter, weighed 200 pounds. The same difficulties which perplex but fascinate the amateur who works on smaller mirrors were eliminated one by one until the mirror looked satisfactory under the delicate Foucault knife-edge test, which easily measures reflecting surfaces within an accuracy of at least one 500,000th of an inch.

After 30 months of work the mirror was approved and coated in a vacuum with aluminum, the newer kind of reflecting film which has supplanted the more familiar film of silver. In the meantime, work on the other parts of the observatory project has been practically completed.

The total weight of the larger dome, 34 feet in diameter, is 34 tons. The lower floor of the building, between the domes, contains an auditorium seating 150 persons, a dark room, astronomical laboratory, workshop, and a heated study room.

Especially interested readers and amateur telescope makers will find technical details on page 376

Ghost Forests

Insects, Number One Forest Enemy . . . Make Ghosts of a Vast Number of Trees . . . Bark Beetle Heads the List . . . Other Insects, Man Combat the Pest

By RUTH RINGLE

CONTRARY to popular belief, the Number One enemy of the forest is not fire but insects. In the year 1932, for example, less than 50 million board feet of timber in California were destroyed by forest fires, while pine bark beetles ravaged 1500 million board feet! In the ten years between 1926 and 1936, the State of California, alone, lost $200,000,000 worth of timber through the activities of these insects.

One day there is a majestic forest of whispering pines, a wealth of scenic beauty as well as of timber. An infestation of bark beetles moves in, and in a few weeks many of the trees are dead. In some areas a whole forest of pines will become white, lifeless ghosts.

Pine bark beetles are not alien enemies that have slipped into our forests unchecked by natural enemies. They are a native menace. For centuries bark beetles have periodically laid waste to pine forests, and in about 150 years a new forest would take the place of dead trees. Such is Nature's deliberate and protracted plan.

The destruction of great trees in their prime may suit Nature's plan, but it is disastrous to men, they cannot wait 150 years for natural replacements of the bark beetles' undoing. We also resent the esthetic and recreational loss to vacation lands.

Suppose a man buys a section of forest land as a summer home for his family. They build a cabin beneath the pines and spend one health-giving, happy summer there. The next year they return and find their trees dying. Bark beetles have ruined their investment in vacation resources. This family would not be philosophical about Nature's long-range plan.

Perhaps a few men pooled their savings and bought a rich stand of pine forest which they planned to harvest in true timber-conservation procedure, insuring not only a life income for themselves, but also a rich bequest to be handed down to their children. Then, before a single log had been cut, an epidemic of bark beetles swarmed in and changed their valuable forest to dying trees. There would be no consolation in the fact that Nature would replace the trees in 150 years.

The Bureau of Entomology and Plant Quarantine of the United States Department of Agriculture has tackled this problem in a thorough and practical way the last few years. They have set a corps of entomologists to study the bark beetle, learn its life habits, its friends and enemies, and decide on the best method of control.

THE western pine beetle, *Dendroctonus brevicomis Lec.*, and the mountain pine beetle, *Dendroctonus Monticolae Hopkins*, are the worst transgressors in ponderosa pine and sugar pine forests. These beetles are always endemic, constantly at their nefarious work, and only waiting for favorable conditions to become epidemic. Bark beetles fly to a pine tree and bore holes through the outer bark to the living tissue, the cambium layer which carries the sap or life blood of the tree, rich moisture, resins and dissolved sugars. At first, the beetles are forced back by the protective flow of pitch, but so many attack a single tree at one time — literally thousands — that within a few days all the sap is exhausted and the tree can no longer fight against its enemies. Then the beetles move in. By pairs, they start boring tunnels through the living tissue of the tree, with a pocket-crib every so often in which the female deposits eggs. Soon the cambium layer is a network of these tunnels.

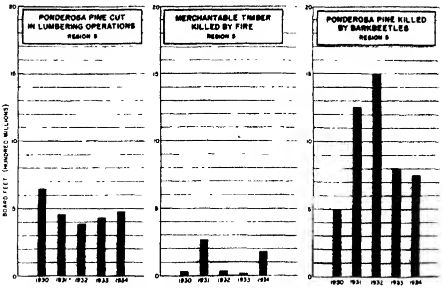
The eggs hatch into larvae which feed on the sugars and other substance of the dying cambium tissue, then become pupae. When growth is completed, the young beetles bore their way out of the dead tree, fly to another living host, and begin a new generation.

When endemic, beetles usually attack only trees which have been weakened by some other cause such as lightning or the attacks of other insects. The largest trees, also, when fully mature, do not have the tonicity to fight the bleeding tactics of beetles, so the most magnificent specimens of pine are constantly prey to bark beetle infestation. Young trees, however, are so tenacious — continuing a drenching flow of pitch — that beetles avoid them, except when the insects reach an epidemic stage. Then all trees are invaded.

Soon after the insects enter, the tree is no longer able to draw enough moisture and food elements to sustain life and the pine needles turn to a sickly yellow, then a yellowish brown, and finally, before the needles fall away, to a red, rusty stage. The dead, whitened trees may stand for some years before they fall.

Besides being a scar of ugliness, these dead trees are a menace to neighboring forests. Dead trees magnify the danger of fire, from whatever cause, by providing added inflammable material to that already on the forest floor.

If logged within a few weeks after a bark beetle attack, trees can be salvaged for some lumber uses, but after about six months, the timber is worthless. The wood by that time is honey-combed by other insects. A fungus-caused "blue stain" discolors the tissues, and dry rot



Comparison of damage to commercial pine stands by lumbering, fire, and beetles

rapidly turns tough fibers to dusty pulp.

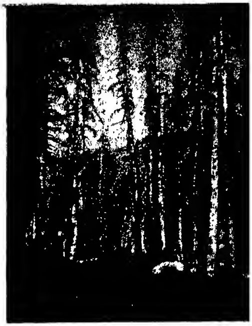
The problem of how to control the attacks of bark beetles was approached from two angles: surveys and laboratory research. By surveying the condition and number of beetles and other insects, and considering the weather factors, it can be fairly well determined whether or not an epidemic is imminent. If so, immediate control measures can be instituted.

IN the mountains east of Fresno there is an unusually fine stand of sugar pine, the most valuable timber material in the forest. This area was recently surveyed. Ground crews marked and mapped all infested trees in this forest while a supplementary reconnaissance from an airplane spotted dying trees by their red crowns. Then insect control crews entered these areas and felled all infested trees, many of which were over six feet in diameter and about 500 years old. The bark was stripped from each felled tree to expose beetles and larvae, then bark and log were set afire. Felling and burning trees that are hosts to beetles has been the most successful method of control so far discovered.

Three years ago the Bureau of Entomology and Plant Quarantine established two field research laboratories in the heart of pine forests, one near Yosemite National Park and the other near

size of the bark beetle he attacks, and he approaches his prey without hesitation, flips it over on its back and nips the beetle in a vulnerable spot. Then he proceeds to make a meal of his victim. The female clerid lays its eggs in bark crevices near holes bored by pine beetles. When these eggs hatch, the young clerid larvae crawl into the tunnels in search of bark beetle larvae on which they feast. This appears a perfect set-up for adequate natural control of bark beetles. But beetles have one advantage, they outnumber their enemies and breed two or three generations to the clerids' one.

Forest entomologists are breeding both green trogositids and red-bellied clerids in their laboratories to determine the feasibility of large scale artifi-



A forest of ghostly gray trees, all kill by an attack of vast numbers of bar beetles on the cambium layer of bar

Bark beetle in the grip of one of his natural enemies, the red-bellied clerid, which devours both the bark beetle and its larvae

Lower left Clerid larva feeding on beetle larva in tunnels beneath tree bark

Lassen National Park. Bark beetles have received the primary attention at these laboratories because they are the most serious problem. Healthy trees were screened and beetles introduced so that the scientists could observe the actions of the beetles and the reaction of trees to the attack.

Then predators, enemies of beetles, were admitted to this living laboratory, and researchers had a ringside seat at a major forest bout. But it wasn't much of a fight, for bark beetles hardly raised an antenna in their own defense when attacked by a green trogositid or red-bellied clerid, their natural enemies.

A red-bellied clerid is about twice the

cial rearing of these predators as a method of beetle control. These preying insects need careful raising, and as they breed but one generation a year, it is difficult to get enough trogositids and clerids to be effective against bark beetles in large areas.

Another factor in favor of the beetles is that clerids and trogositids do not depend solely on bark beetles for food. They like a varied diet, so that even if the predators were not outnumbered by the beetles, they could not be depended on to wipe out the pests. However, entomologists are still working on the problem and hope to find a way to breed these predators more economically and abundantly, or to discover other more practical and effective parasites or predators. Somewhere else in the world such a parasite may be found.

Other methods of control have been tried. Toxic oils that seep into bark and poison the insects and larvae are successful on thin-barked trees, but as pine bark beetles usually attack trees with thick bark, toxic oils are no threat to them.

Entomologists are studying a bark beetle disease, an organism on the borderline between plant and animal life which sometimes wipes out an epidemic of beetles, but little has been learned. If this plague could be introduced by foresters when an epidemic of beetles threatened, it might be the simplest method of control.

It will probably never be possible to wipe out bark beetles completely, but even the control program now in use, felling and burning infested trees, if applied thoroughly and consistently, would prevent devastating epidemics. Wherever this method has been used, it resulted in a loss-reduction of 50 percent to 80 percent.

Aside from the loss of trees, these depredations of beetles entail further problems. Trees, above all things, are a natural control for floods and excessive soil erosion. Pine forests are an important part of our national wealth, and are the basis for many industries and jobs besides those of actual lumbering operations. But who can measure the esthetic loss? Great trees have been the inspiration of men since life began. And thousands of Americans seek refreshment and rest every summer in our forests.

Foresters agree that an effective control program must include plans for thorough and basic research, must be sufficiently wide in scope to include any territory from which infestations could migrate, and should provide for sustained effort over a period of years.

Science and Industry

A MONTHLY DIGEST

Conducted by F. D. McHUGH

Contributing Editor
ALEXANDER KLEMIN
In charge, Daniel Guggenheim School of Aeronautics, New York University

Indian Arrow Poison For Arthritis, Mental Disease

TWO powerful poisons, cobra venom and curare, the old Indian arrow poison, have been put to use in healing two wide spread human afflictions — arthritis and the mental disease schizophrenia

In schizophrenia, the Indian arrow poison protects patients from injury during metrazol convulsions which are used to shock them back to sanity Good results with this combination of curare and metrazol are reported by Dr A E Bennett, of Omaha, in the *Journal of the American Medical Association* Dr Bennett cautions against general use of the poison with metrazol until further experiments have been made He has also been using it "with encouraging results" in treatment of children suffering from spastic paralysis

Deadly cobra venom injected into the muscles of patients suffering from neuralgia and various rheumatic conditions caused slight or moderate improvement in a little over half the cases, Drs Otto Steinbrocker, George C McEachern, Emanuel P La Motta and Freeman Brooks, of New York City, report Other methods of treatment had failed to relieve almost all the patients Patients with rheumatoid arthritis were helped more by the cobra venom treatment than those with other complaints The venom was first given in small doses as recommended by Dr D I Macht, of Baltimore, but larger doses were soon found necessary — *Science Service*

Enamels for Plastics

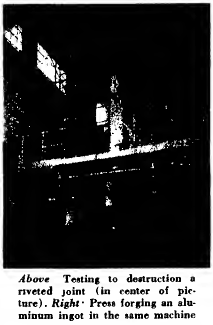
THE wide use of plastics in bulk for such things as radio cabinets, electric iron handles, and the like has long posed a problem to researchers To put color in these plastics, expensive pigments are necessary. Yet Sherwin-Williams Company chemists felt that the color need not go deeper than the surface They set about finding enamels that would do the trick, and have recently announced one called Kem Bakolescent in the irridescent form, and Kem Plastite in solid colors These enamels work where formerly no coating would adhere to the smooth, greasy surface of plastic moldings

These new enamels can be dipped or sprayed on plastic parts, and combine any color of the rainbow with an extraordinarily long-wearing surface. Moldings which are now being finished with these new coatings are for vacuum cleaners, electrical wiring devices, and automobile parts

Most Powerful Testing Machine

A NEW type of precision metal working machine, which is also the world's most powerful testing machine, was demonstrated recently at the Aluminum Research Laboratories

This huge piece of equipment, called



Above Testing to destruction a riveted joint (in center of picture). *Right* · Press forging an aluminum ingot in the same machine

the Templin machine after R L Templin, chief engineer of tests of the Aluminum Company of America, is capable of exerting a force of 3,000,000 pounds in compression and 1,000,000 pounds in tension Research executives point out that while it is not the largest machine of its kind, it is the most powerful, for it can exert these forces at speeds up to 36 inches a minute — faster than any other testing machine, and, since power equals force times speed, the claims made for the machine are evident

The new machine, built by the Baldwin-Southwark Corporation, can be operated as an extrusion, forging, or forming press In addition, it is provided with auxiliary equipment which will permit defining, within close limits, the relationships existing between the various forces involved in the plastic flow of aluminum throughout a wide range of conditions

The over-all height of the machine is 40 feet, 4 inches, of which 25 feet is above the floor line, the rest below It is 16 feet, 4 inches wide and 9 feet front to back

Nodules for Insulation

HARD SHELLED, light weight nodules of processed and puffed clay that have been produced by the Kraus Research Laboratories are being used in several types of insulation They may be used as a filler in building blocks, hollow tile, stucco, wall plaster, partition boards and the like.

These nodules, which may average a quarter of an inch in diameter, are made of fatty clay or shale having high carbon content If the clay or shale is deficient in carbon, the manufacturers add a solution of glucose, pitch, or soft coal finely ground, as gas forming substances Sometimes it

is necessary to add Bentonite as a plasticizing agent, this material acting also as a flux When heat is applied, the semi-plastic body stretches into a balloon shaped piece because of the confined gases from the carbonaceous material When properly heated the surface is glazed to a hardness that will withstand pressures used in the process of making building blocks

90mm Antiaircraft Gun

TO supplement the Army's 3 inch anti aircraft gun, a new 90mm weapon was recently announced by the War Department Some comment regarding this has appeared in the daily papers but so far no technical details have been released for publication and probably will not be released The size of its shell, 90mm, or slightly over 3.54 inches, will indicate its increased power over that of the three-inch

Both the gun and its ammunition have undergone technical and engineering tests and have been standardized Hence, some of these guns will be procured instead of three inch type which are now being manufactured under current appropriations

Roof Water Cools

SINCE the time when primitive man finally crawled out of his cave home to conceive a habitation of his own creation, centuries of effort and millions of dollars have been expended in draining rain and snow water from rooftops

Not until our present civilization and the recent developments of air conditioning did man begin adapting water as an insulation and seek means to hold it captive on roofs to turn back the sun's heat in summer and reduce the escape of inside heat in winter.

For the builders of commercial and industrial structures, the Koppers laboratories in Pittsburgh have developed roofs which are capable of holding pools of water for insulation They have been found to reduce the temperature in upper stories as much as 10 degrees in summer This is as great a change from outside summer temperature as has been found healthful in air conditioned buildings

Structures with air conditioning, too, are using pool roofs because they make it unnecessary to dispose of water once it has circulated through the system Now it can be pumped to the roof, cooled of its absorbed heat, and re used over and over again.

RUBBER

ACCORDING to the *Chemical Digest*, of Foster D. Snell, Inc., "rubber" supplies are about 1 percent synthetics, 28 percent reclaim, and 61 percent crude rubber.

It Started with Maggots

DURING the World War it came to the notice of medical men that bad wounds that became infested with squirming maggots of the blowfly healed much more rapidly than the same type of wound uninfested. Search for the reason finally centered upon a secretion of the maggots called allantoin. Further study found that one constituent of allantoin was the effective curative agent This chemical was urea Now it has been found that a still simpler chemical, ammonium bicarbonate, has the same effect as urea Ammonium bicarbonate is formed naturally from urea by the action of an enzyme, urease A 1 percent solution of this chemical is effective whether used as a wet pack or for irrigation of an open wound Some of the conditions cleared up by the new treatment were chronic osteomyelitis, diabetic and varicose ulcers, middle ear infections, stitch abscesses, infected lacerations, and other purulent wounds

Portable Printer

ANEW portable printer, announced by the Ozalid Corporation, was designed to use positive printing, dry developing Ozalid sensitized papers and cloths It is claimed that it will reproduce engineering drawings, letters, reports, maps, in fact, any pencil or ink lines, typewritten or printed matter appearing on one side of a reasonably translucent sheet

The light source consists of six specially developed lamps A new feature is a dry developing chamber, which is conveniently located behind the metal reflector, utilizing the heat generated by the lights to vaporize the developing agent

This light and portable unit can be carried from place to place, and used either in

Printer, lid removed to show lights

the office or in the field on the job Since no moist surface developing solutions are used, no washing, fixing, or drying is required In an office, prints can be conveniently made at a moment's notice by any office employee The cost of making prints on the Elpro Portable Printer is but a fraction of the cost of making such reproductions by other photo-copy methods

To Detect Metal Buried in Logs

A DEVICE for detecting spikes and other metal objects buried in logs has been developed by the Forest Service, U S. Department of Agriculture Metal objects in logs are potential causes of costly and sometimes fatal saw-smashing accidents

The device was developed for use in connection with lumbering operations in New England, because an unusually high percentage of "blow down" timber in some sections hit by the 1938 hurricane was found to conceal old fence nails, hammock hooks, spikes, abandoned sugar sap spouts,

Exploring coil and detector box of device for locating hidden metal

and even sections of forgotten scythe blades Near Vermont marble quarries miscellaneous bits of iron and rock, apparently blasted into the tree trunks and grown over, also have been found, as was a jackknife left perhaps by some initial carver of other days

The detector is easily carried by one man When the exploring coil with which it is equipped is held near a log in which metal is imbedded, the device sets up a howl By moving the coil the operator is able to locate the exact position of the buried metal Armed with this information, the sawmiller then chops out the metal before the log goes to the saw and a possible crack up

The detector consists of a box about the size and appearance of a portable radio set, to which the flat, ten inch exploring coil is attached by a six-foot, flexible wire By means of a shoulder strap, the operator carries the box upon his hip so that adjustment knobs controlling batteries and circuits rest under one hand The exploring loop, or coil, is handled with the other Headphones are provided so he can better catch the detector's howl amid other sawmill noises

When the instrument is turned on, an audio tone signal is set up in the head phones By twisting the knobs, the operator balances out the signal When the exploring coil is brought into the vicinity of any metallic object the balance is disturbed and the audio tone signal is heard anew

PEANUT BUTTER

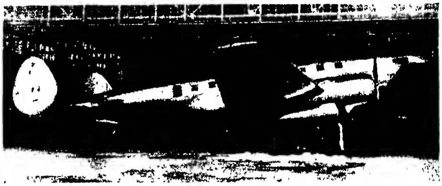
THE oil does not separate from peanut butter when 2 percent of glycerin has been added. Glycerin is, of course, a food.

2000 Degrees Fahrenheit Portable

A GENERAL utility torch of improved design has been introduced by the Utilitorch Company Primarily designed as a weed burner, it also serves as a disinfecting torch, tar-pot heater, and pre-heater for welding

Due to the fuels used — kerosine, distillate, stove and fuel oil — the coils on previous units became clogged with carbon and required frequent replacement How-

Bow and side views of the largest twin-engine airliner



ever, a specially shaped generator on the new unit, known as the Utilitorch, provides easy cleaning by simply removing the generator shell and reaming out the carbon Also, the new generator allows a more uniform application of heat to all the surfaces, giving greater fuel breakdown, more heat, and less carbon formation.

Both the generator tubes and generator shells are made of Inconel to withstand heats in the neighborhood of 2000 degrees, Fahrenheit The Utilitorch is available in five models from the standard hand model to the giant model for tractor and truck attachment for burning weeds along highways, irrigation ditches, and canals

Largest Twin-Engine Airliner

MANY airline operators are of the opinion that to build four-engined planes is to lose operating economy, that two powerful engines give all the safety and reliability necessary, that a twin-engined plane will be more economical to operate, besides being cheaper initially. The experienced executives and engineers of the Curtiss-Wright Company hold the same opinion and have backed this opinion with the expenditure of perhaps a million dollars in the construction of a fine twin engine machine

The specifications are, briefly 108 feet in span, 75 feet in length, 38,000 pounds in weight, fully loaded, 1000-gallon fuel capacity, 36 passengers by day and 20 in berths at night, two 14-cylinder Wright Cyclone engines with 15-foot propellers, top speed, 243 miles an hour, cruising speed, 210 miles an hour at 10,000 feet altitude

We have become so accustomed to the fact that transport airplanes provide more luxurious accommodations than the best Pullman that it is hardly necessary to speak of comfortable and adjustable reclining chairs, sound-proofing, ventilation, heating, and so on Let us concentrate rather on some of the novel features in the design of this new aircraft

The airfoil has been so modified at the tip that aileron control can be retained below the stalling speed Thus the plane can execute a three-point landing at minimum speed without "falling off on one wing" The flaps installed inboard of the ailerons move directly aft during take-off to improve the run and subsequent climb On landing they are also revolved downwards to accomplish air braking Blind flying technique will be further extended, and aircraft may then have to "mush" straight into the ground In anticipation of such development, the gear is designed to permit landing with a rate of descent of 800 feet per minute, with the necessary cushioning provided by extremely long shock absorber travel.

The geometry of the landing gear has been so worked out that when the airplane is on the ground there is no possibility of the landing gear folding, even if the pilot applies power to retract it. As long, in fact, as the weight of the airplane is on it, the landing gear cannot be retracted

It is a great help to the personnel to have only two engines to watch. To simplify their task further, Curtiss-Wright engineers have reduced the number of flight controls by one third This has been accomplished with the aid of a "Tell-Tale" safety device which automatically checks the functioning of 50 major instruments, flashing a warning signal in one spot when any instrument is indicating a hazardous condition To permit normal cruising at 20,000 feet with an equivalent "cabin altitude" of 6000 feet, pressure in the fuselage is obtained by the use of two centrifugal blowers in the engine compartment. An interesting aerodynamic innovation is to be found in the engine cowling. The air is introduced into the cowling at the front and circulated around the cylinders in the conventional manner. But after the air has done its cooling duty it is discharged through a single passage below the nacelle It is reported that considerable reduction in drag is thus obtained - *A K.*

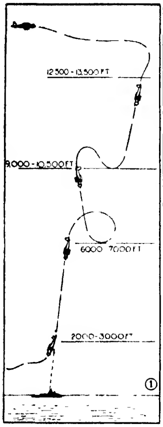
Safety Planes for Private Flying?

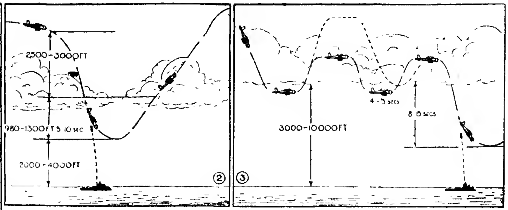
THE Civil Aeronautics Authority is doing a fine job in its various activities of safety regulation, aids to scheduled navigation on the airlines, training of college men in flying, and so on But again and again rumors reach us from Washington that the C A A will encourage private flying by sponsoring the construction of a miraculous safety plane, which will be cheap, efficient, and perfectly fool-proof So good will be this new design that anyone taking flight instruction in the new safe plane will be permitted to solo or secure his first certificate in a shorter time than when using a more conventional machine

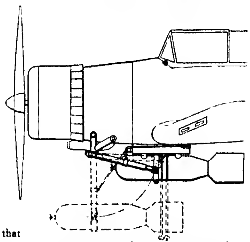
Remembering the sad history of the $700 "flivver" plane, we pray that the Civil Aeronautics Authority will undertake no such adventure rashly There is no such thing as a completely fool-proof plane and there never will be, just as there is no fool-proof automobile and never will be Whenever an engineer deliberately undertakes the design of a "special safety" plane he fails. Safety of the airplane increases by evolutionary steps, slowly because each new idea has to pass through the various stages of laboratory experimentation, experimental construction, and long experience in service, before it can be fully accepted. Safety of aircraft advances always, but there can rarely be "jumps" or "sports" as the biologists term it

Moreover, we are convinced from recent personal experience that the modern private plane is already remarkably safe, easy to control and maneuver. Quite recently, when given a chance to fly the Luscombe small two-seater, we noted with satisfaction the lightness of control and the stability that this typical light plane provides for the novice pilot. When the stick was pulled all the way back, the ship nosed up, oscillated one or twice, but never fell off on a wing This behavior in itself is a real element of aerodynamic safety. When compared with the war time Jennies and other early training planes, the present state of the art savors of the miraculous.

What is far more important is good instruction of the student pilot on a sys-







The three numbered drawings show different dive-bombing maneuvers that are used according to cloud conditions. *Left:* Displacing gear for releasing aerial bombs

tematic, well worked out plan such as that of the C A A program Of equal importance is the indoctrination of all student pilots in avoiding over-confidence and showing off Accidents in private flying, as analysis indicates, are not likely to be due either to structural or engine failure or the flight characteristics of the airplane, but to some rash or misguided effort of the young pilot, who after 40 or 50 hours in the air, believes himself to be equal of a Lindbergh or of an Al Williams — *A K*

The Art of Dive Bombing

IN these parlous times we must perforce be interested in such gentle arts as dive bombing, and an article by H F King in *Flight* is illuminating

Dive bombing is defined as the release of a bomb or bombs while an airplane is diving steeply towards a target Previously, dive-bombing with heavy projectiles was regarded as of use only in attacks upon ships and in the Spanish war a single pilot is said to have accounted for the destruction of three large steamers But the German attack on Poland showed the value of the method in attacking tanks, and generally in support of infantry The speed of the dive increases the vertical velocity of the bomb so that its penetration is equal to that of a projectile released in level flight at a great altitude. Aiming for the target is of course much simpler than in bombing from great heights. Therefore, in spite of the fact that the dive bomber is peculiarly vulnerable to shell fire at low altitudes, dive bombing must remain a powerful aerial tactic.

The bomb itself, which may weigh as much as 1000 pounds (with heavy casing where penetrating power is required) is placed under the fuselage. A simple displacing gear, shown in the sketch, is operated to release the bomb The airplane itself must have special characteristics It must be strong enough to withstand the sharp pull out which follows the dive, highly maneuverable so as to keep the anti aircraft gunner guessing; it should preferably be a twin-engined machine to give the pilot better vision and facilitate clearing of the projectile, and, finally, it should be equipped with a double flap, one opening below and one above the wing surface to check the speed of the dive and thus secure better aim

The technique followed is illustrated by the accompanying diagrams In clear weather there is an approach from great altitudes, with intervening spirals When there are some clouds the military aviator seeks to fly above the clouds and only penetrates the clouds to release his bomb When there is an unbroken layer of cloud, he flies above, pierces it, and then flies through again until he is almost above the target —*A K*

Industry Borrows from the Housewife

OUT of the kitchen has come the inspiration for the latest important development in the metals industry — the efficient melting of zinc in industry The humble double-boiler with which Mrs Smith cooks her vegetables to just the proper turn has been adapted, on heroic scale, to smooth the wrinkles from the brows of industrialists plagued with the expense and impurities of conventional methods.

Down at the Glenn L. Martin Company aircraft factory has been developed this useful system, because Martin uses much of the metal in making dies for bombers and over-ocean transport ships

Heretofore, zinc has been melted simply by putting it in a pot and then putting fire under the pot. But heat has concentrated at certain points, the zinc has alloyed with the pot metal at these points, and the melted product usually turns up with impurities. In addition to this, the pots have been short-lived, eroding at the points of maximum heat

It was to produce better metal for die-making, and at the same time reduce the cost of pot replacement, that the Martin research staff developed the double-boiler idea They built a big pot with a combustion chamber underneath (for gas, oil, or coal) and covered it with refractory material In this they melt lead and into the molten mass they dip another pot containing the zinc Since the heat thus is evenly distributed over the pot, there is no tendency for the zinc to alloy with the pot, the metal is returned in molten form in a high degree of purity, and the inner pot is spared the eroding effect of the zinc at points of extreme heat

Bonded Carbon Steel-Stainless Sheet

A NEW bonded sheet of carbon steel with a surface of stainless steel takes advantage of the cheapness of the former and the attractiveness plus corrosion-resistance of the latter This new sheet is made by the Allegheny Ludlum Steel Corporation Plant and is called Pluramelt The process produces single ingots of two or more compositions integrally bonded together Wire can also be made by the same process

The bonded material lends itself to standard shop practices as it can be fabricated in any of the usual methods

Radio-Active Spark Plugs

A METAL which has a commercial valuation of $2,000,000 an ounce is now being used in spark plugs made by Firestone. Polonium is the metal, and it is used only in minute quantity As a result of this use, the manufacturers, The Firestone Tire & Rubber Company, claim better motor performance and quicker starting; and say, further, that many drivers using these spark plugs have reported appreciable savings in fuel.

The air around spark plug electrodes is

not normally a good conductor of electricity and must be broken down into ions by high voltage before it will conduct the spark between the electrodes This ionization takes time and may contribute to the sluggishness of a motor But, since polonium gives off 4000 times more alpha rays per second than radium, the polonium electrodes are emitting rays constantly in all directions, thus keeping the air in the spark gap ionized It is, therefore, at all times a good conductor of electricity.

Under-Feed Stoker Aids Pipe Smoker

A SMOKING pipe with an under-feed stoker is the development of Briar Hill Corporation This stoker, which can also be fitted to a smoker's present favorite pipe, is an aluminum screw-fitting in which

" . a cool, dry smoke"

is mounted a screw topped by a perforated aluminum grate

When the pipe is loaded the elevating screw is all the way down in the pipe, providing maximum tobacco capacity As the tobacco burns down, the elevating screw is given a turn or two, raising the fuel The elevator is thus run up, leaving a dead space below the grate in which juices can collect without affecting the tobacco's taste

The Briar Hill Stoker promises the smoker a cool dry smoke with no accumulation of soggy heel in the base of the pipe

How to Pile Industry's Coal

A THOUSAND tons of coal a day — that's the requirement of The Dow Chemical Company And when any one industry's coal requirements reach figures as large as that, several major problems of handling and storage present themselves

For three years now, this company's unique and revolutionary coal handling and storage methods have been attracting nation wide attention Wherever coal is used in huge quantities, these methods are either being studied or have already been adopted

Until 1937, the coal was stored in conical piles of 8000 to 12,000 tons each. Coal was dumped directly from lake boats Slack was piled loosely just as it fell, allowing free entry to air. In such a pile, natural classification soon caused a separation of fine and coarse particles, the former being more firmly compacted than the larger pieces. When a second load was piled on the first, the same thing happened, likewise with each succeeding load In case of fire the layers operate like flues in much the same fashion as their counterparts in chimneys

It was often found necessary to re-pile the coal in order to eliminate this fire hazard This involved expense, but the cost was minor compared with the loss sustained when fires started

Coal is now stored in horizontal rather than oblique strata This eliminates the formation of flues and reduces the fire hazard There is little need to fear spontaneous combustion since coal is packed so tightly that little of the fire-breeding oxygen can filter in Without oxygen, the coal, of course, cannot oxidize. In the three years that Dow has been storing its coal thus, no rises in temperature have been noted, even after 18 months of continuous storage Formerly the average rise was one half degree per day

Equals Low Fuel Consumption Mark

THE low fuel rate of 0 545 pounds of oil per shaft horsepower, set by her sister ship the *Challenge* and believed a world record, has been equalled by the new *Red Jacket* on her official trial run The ships are two of five cargo vessels completed last year by the Federal Shipbuilding and Dry Dock Company at Kearney, New Jersey, as part of the extensive construction program of the U S Maritime Commission Both ships have General Electric geared turbine propulsion and are capable of developing 16 knots They are single screw, 6000-horsepower, 92-revolutions per minute, with steam conditions of 440 pounds, 740 degrees, Fahrenheit, total temperature, and 1½ inches absolute back pressure A sixth vessel is nearing completion, and Federal is starting construction of eight more such ships with the same type of propulsion

Sub-Irrigated Seed Flat

A NEW type of seed flat designed for use in the home, the cold frame, the hot house, out-of doors, or for purposes of research in the laboratory, has just recently been introduced by the Waterite Seed Flat Company

Measuring 12 by 14 by 3 inches, it is made of rust-resisting metal and employs an entirely new method of watering which

Getting water to the roots

allows for sub-irrigation without any messy leakage of soil or disturbance of seed or seedlings as so frequently happens with above-ground watering An inner plate having widened openings at each end and perforations in the corrugations in the bottom, permits water to be poured in and seep up through the perforations right to the surface of the soil Usually two or three quarts of water are sufficient for moisture to appear evenly over the surface Then a screw plug in the bottom of the flat is withdrawn so that any excess water may be removed Further watering is not usually necessary for a week or ten days Air circulates through the end openings and the corrugations in the inner plate so that the soil is kept sweet and in good condition

This new type flat is also excellent for transplanting as it is only by sub irrigation that one can be sure water is supplied directly to the roots Surface watering rarely penetrates more than ¼ to ½ inch and, naturally, dries out more readily than when sub-irrigation is applied to the plants Any possibility of damping-off is avoided by sterilizing the soil in the usual manner — *(F Greeves-Carpenter.*

Non-Drying Modeling Clay

MODELING in clay has disappointments other than the unexpected errors in appearance which the fingers of the modeler may unintentionally make. There is the problem of clay hardening This may take place overnight if the unfinished model is not covered with wet burlap or unless some other means are employed to keep the clay surface soft enough so that additional clay will adhere firmly. Greatest irritation and expense to modelers

***Red Jacket*, cargo vessel that equalled best fuel economy record**

result, however, because the clay cannot be used over again once it has hardened thoroughly.

Manufacturers of articles molded from glass, metal, synthetic plastics, rubber, and similar materials may wish to use clay mixtures for producing "visuals" before production begins. This new clay mixture enables such manufacturers to save time by making alterations in the models instead of making new models because the usual clay types harden quickly.

To make modeling clay retain its plasticity for long periods, small quantities of glycerin and petrolatum are added. The glycerin attracts water to the mixture, keeps it soft; the petrolatum gives the mass the desired consistency. Either 00 Petrolatum or Amber Parmo is suitable for this application. The amount to use depends on the consistency desired. The amount of glycerin also may be varied, depending on the length of time the modeler wishes the finished model to retain its softness, or the number of times he wishes to use the clay. — *Esso Oilways.*

Electric Stopwatch

DIFFERING from the conventional stop watch, a new device, Time-It, made by Precision Scientific Company, has a direct-reading counter mechanism driven by a synchronous motor. The principle of operation is the same as that of the ordinary electric clock and the accuracy is said to be "equal to the cycle constancy of a 60

cycle a. c. supply at 110 volts." The five digit counter reads directly to 1/10 of a second and integrates to 10,000 seconds before running back to zero. Readings closer than 1/10 of a second can be interpolated and the counter can be instantly reset to zero from any reading.

Stopping and starting are by push button. A built-in brake eliminates "coasting" when stopping the timing operation. The device is said to be practically noiseless in operation. It should find wide use in all types of laboratories where exact controls are necessary.

White Chromium

MANY firms are now actively studying the possibilities of white chromium solutions because of the saving in plating time, much better throwing power, lower current densities, and resultant improved production. A wider bright-plating range, along with lower current densities, reduce burned edges and rejections.

White chromium is flexible, very resistant to peeling, rust-proof, non-tarnishing, and white. Other concerns are investigating the promising possibility of white chromium for barrel and basket plating which would

result in unprecedented savings as a consequence. The conversion of ordinary chromium solutions to white chromium solutions is a simple matter requiring mere addition of a special patented compound "Triskalite" to the original solution under certain conditions.

SANDING DRUM HAS INNER TUBE

A SANDING drum which relies on an inflated rubber inner tube to hold the abrasive band in place is being manufactured by Mall Tool Company. Finer finishes, with less danger of tearing the work or putting excessive wear on the abrasive

Air pressure holds the band

bands, are promised. The Mall Pneumatic Sanding Drum is easy to apply to any flexible shaft machine, bench grinder, or aerial grinder.

The drum is a lightweight aluminum casting, having a special, flat rubber tube mounted on its outside face. A fabric band and the belt of abrasive material are slipped over the deflated tube and into correct position. Then a few strokes with the air pump inflate the tube, and the belt is held firmly in place.

The Mall drum can be fitted with any one of several grades of abrasive belts, from very coarse to very fine. The light weight of the aluminum drum is a great advantage when the device is used on a portable grinding tool that must be hand-held and carefully manipulated in grinding castings and finishing fine surfaces. — *Aluminum News-Letter*

LAKE BROMINE

THE American Potash and Chemical Corporation is installing facilities at its plant at Trona, California, to recover bromine from products resulting from the evaporation of Searles Lake brine.

The bromine concentration in Searles Lake brine is about 12 times that of sea water, and since large quantities of brine are processed in the Trona plant for the recovery of potash, borax, soda ash, salt cake, and other chemicals, a considerable amount of bromine is available. During 1939 over 1,000,000,000 gallons of brine entered the Trona plant, carrying nearly 10,000,000 pounds of bromine, or an average of over 13 tons of bromine per day.

Theoretically, the main Trona process is a cyclic one of alternate concentration and fractional crystallization in which the brine is ultimately evaporated to dryness, with separation and recovery of the various salts

contained therein. Thus, in certain of the concentrated liquors, the bromine concentration reaches 100 times that of sea water It is from such concentrations that the bromine is to be recovered as a by-product

Desk Organizer

A HORIZONTAL filing cabinet for use on a busy executive's desk, where he can keep important papers that will need attention in the near future, has recently

In this horizontal filing cabinet there is a choice of 45 standard titles for identification of contents

been developed Known as the Miracle Desk Organizer, this compact filing cabinet is equipped with classified folders large enough to take legal-size papers

"Case Hardening" Concrete

IT has been discovered that if concrete forms are lined with absorptive, finely textured material such as Fir-Tex insulating board, the concrete will develop a hard, dense surface which might be called case hardened The absorptive board case hardens the surface of the concrete by removing trapped air and excess water Concrete formed with these boards possesses a very dense, voidless, outer layer extending to a depth of about one and one-half inches

Tetanus Toxoid

TETANUS is one of the most serious problems of wartime medical science An open wound may pick up the germ from soil, manure, or ordinary highway dust

Commander W W Hall, U S Navy Surgeon, recently announced that a toxoid for vaccination against the disease has proved so successful that after injections of two doses eight weeks apart, the individual becomes a walking antitoxin factory He says, further, that the entire Naval Academy personnel has been vaccinated against this disease and if wounded, will never again need to be injected with horse serum or face the danger of serum reaction

More Shaving Science

THE Mellon Institute fellowship of the Magazine Repeating Razor Company is enabling E J Casselman to investigate the variability in safety razor blades and its causes on the one hand, and the variability in shaving conditions on the other, including their relations to user satisfaction (Mr. Casselman wrote for Scientific American, November, 1937, an illuminating discussion of some of his findings.)

It has been found that there are some 31 variables in shaving conditions that influence user satisfaction, of which the more

important are: time of beard softening, temperature of softening water, hydrogen ion concentration of soap or other medium, time elapsed since prior shave, and condition of skin and hair as influenced by fatigue, by sunburn and windburn, and by dietary factors The variation introduced by these factors is roughly twice as great as that in the over-all quality of new razor blades as produced by the better blade makers. A study conducted in supplement to this investigation has shown that there are some 24,000 hairs, each about 0 006 of an inch in diameter, that the typical man has to shave on his face and adjacent portions of his neck. The effective length of most safety razor blades may be considered to be divided into 240 segments, each 0 006 inch long. It follows that the minimum amount of work required of each such segment in an average "once over" shave is to sever 100 hairs. Still more work is required in the usual case where the skin is shaved over more than once The degree of hair softening by the facial preparation before shaving determines in part how many hairs can be cut before the blade becomes too badly dulled for further use

MILEAGE

THE United States has far more high-speed railroad mileage than any other country Today, runs scheduled at 60 miles or more per hour total 65,034 miles, of which 54,956 are completed daily Runs booked at 70 miles or more per hour cover a total distance of 8068 miles

To Keep Cats Away

A BOON to owners of cats is Pussy Scat, a new powder which keeps cats off chairs and beds and away from curtains, table legs, and other objects on which he likes to use his claws Pussy Scat is sprinkled lightly on or around the places that the cat must avoid It is harmless, invisible, and odorless to humans when used in accordance with the instructions Yet the cat smells it, and stays away It ends the shedding of hairs on chairs, beds, rugs, and so on, and prevents other "cat damage" in the house Pussy Scat is made by the Sudbury Laboratory, makers of indoor and outdoor dog repellents

Sprayed Mirrors

SINCE mirrors were first made, the silver reflecting medium has been applied to the back of the glass by a slow process of flooding the glass with the solution by hand The solution then must remain on the glass surface for 20 minutes to an hour to secure a satisfactory deposit of silver After a long period of research, the Peacock Laboratories, Inc, a division of Libbey-Owens-Ford Glass Company, have developed a new process which involves spraying of the solution on glass as it passes down a production line. With this process, 12 square feet of silver film can be deposited on a glass surface in less than 60 seconds according to *Chemical and Chemical Engineering News*

Two overhead containers hold a silver ammoniomitrate solution and a specially

developed reducing agent From these tanks, the two solutions are forced by compressed air through a two-nozzle spray gun. The nozzles permit the sprays to meet about seven inches in front of the nozzles so that the two solutions are atomized It is at this point of mixing that the silver starts to precipitate.

The hazard of chemical and handling damage occasioned by the variable of human skill is reduced to a minimum, since the glass plates, after being placed on the slat conveyor and washed are not touched by the operators until completely processed

The silver reflecting medium deposited on the glass surface by spraying is said to be extremely white and brilliant, and to reflect greater detail, truer colors and distance It is a tough, tight, dense, homogeneous film with durability and longevity

Versatile Laboratory Mixer

Described as an "all-around laboratory mixer" the Model "F" Laboratory Mixer has been announced by the Mixing Equipment Company

Aside from its portability and ease of handling, the chief feature of this new

Increasing torque with slow speeds

mixer is its adjustable speed friction drive It provides constant horsepower at the propeller and increasing torque with slow speeds A turn of a conveniently placed thumb screw increases speed up to a maximum of 1750 revolutions per minute, or decreases speed until the mixer is barely turning over

The new model, mounted on a special ring stand clamp, may be used on beakers as small as 300 cubic centimeters without spilling or "throwing out" contents They have been used on tanks up to 20 gallons in size to produce gentle agitation A convenient carrying handle makes it easy to use as a hand mixer without clamp or stand.

This mixer is recommended for use with inflammable materials since the motor is totally enclosed.

Optical Test for Cancer

A NEW optical test that tells whether a person has cancer and whether, after operation, that cancer has been successfully treated, is claimed by Dr. M. W. Mettenleiter, New York surgeon, connected with

St. Clare's Hospital. In a preliminary series of 325 cancer cases, the test is reported to have proved 96 percent correct

Developed from German studies reported over the last 30 years, the Mettenleiter test involves the measurement of the densities of a number of samples of the person's blood serum by use of an interferometer The blood serum from the patient is mixed with an extract of human cancer cells from a patient known to have carcinoma of the breast

Varying amounts of the suspected patient's blood serum are placed in four test tubes containing equal amounts of the cancer extract After incubation and settling, the densities of the four dilutions are obtained, and plotted out graphically The curves are reported to show a characteristic difference between cancerous and the non-cancerous blood serum — *Science Service*

ALCOHOL

PRODUCTION of ethyl alcohol for December, 1939, was 22,080-109 proof gallons, while the production of specially denatured alcohol was 10,502,486 wine gallons. For the corresponding month in 1938, the figures were 16,780,614 and 8,372,981, respectively

Ink Crust Solvent

PRINTING plates, type, fountains, halftones, and other printing equipment often become coated with hard incrusted ink, but a new solvent called Fedroid instantly removes such incrustations, leaving no residual odor or film of grease This material is a compound of several chemically pure solvents and will not injure fabric, wood, paper, or the operators' hands It leaves metal surfaces bright and clean without pits, etching, or other effects of chemical action

Weight Gain and Loss in Women

A REGULAR gain in weight of about two pounds during one week in every month, with subsequent loss of this gained weight, occurs in about 50 percent of women as a result of monthly variation in sex hormone activity, according to Dr George W Thorn, of the Johns Hopkins School of Medicine, Baltimore This weight gain, unexpected and perplexing, has caused much discouragement to women on reducing diets and even to the physicians prescribing the diets, Dr Thorn pointed out The two pounds gained is due in part to retention of excess quantities of water and salt, as a result of the regular change in sex hormone activity — *Science Service.*

No More Leaky Faucets

DO YOU know anything more annoying than the steady drip of water from a leaky faucet? Well, did you ever do anything about it, besides trying to twist the faucet down tighter? If you're like most of us, you put off installing a new washer as long as possible. However, one designer *did*

do something about the problem—he developed a faucet that stood up under several million closures

The faucet and valve which successfully survived this unusual laboratory test work on a ball bearing principle The upper race of the bearing is attached to a bolt which, in turn, becomes part of the stem assembly. The lower race turns freely on

Ball-bearings do the trick

this bolt and holds a soft neoprene washer in position As the faucet and valve are turned down, the bottom race of the bearing rotates with the upper race until the washer touches the valve seat Thereafter, the bottom race does not turn On further turning, the soft washer compresses against the valve seat to effect a leak proof seal

There are many advantages claimed for this ball bearing faucet and valve A few of them are the mechanism prevents faucet dripping, saving owners considerable expense, it reduces fuel costs and saves replacements and annoyances, it eliminates rotative wear caused by twisting the washer tightly down on a metal seat, the faucet can be opened and closed by mere finger tip action, this smooth up and down action, instead of violent twisting, permits the use of a soft neoprene cushion It has been found that the neoprene washers can withstand extremely hot water for an indefinite period of time

Metal Etching Solutions

FOR etching aluminum and its alloys, Dr B Egeberg and N E Promisel recommend, in *Metal Industry*, that freshly polished and cleaned specimens be warmed in hot water and treated immediately with the following etchant Nitric acid, 1 volume, hydrofluoric acid, 2 volumes, and glycerin, 3 volumes White metals such as tin, lead, antimony, bismuth, and their alloys, as well as Britannia metal, may be etched with the following Nitric acid, 1 volume, acetic acid, 3 volumes; and glycerin, 15 volumes After etching, rinse in running water and dry in an air blast.

Chemical "Ice" for Skating

FOR many years attempts have been made to develop a chemical ice for year-'round skating rinks Some success has been had with such simple chemicals as sodium hyposulfite, which is the commercial hypo used by photographers. Skating surfaces made by using some of these products have been satisfactory to a degree but all have had certain disadvantages.

There has now been brought to a high point of perfection a combination of chemi-

cals called Iceolite. This is claimed by *Chemical and Chemical Engineering News* to be the first substance which permits year 'round, unrefrigerated ice skating. It was conceived by Bessie Pastor Berliney some years ago and is now manufactured by the Iceolite Corporation.

Iceolite has a number of advantages, not the least of which is that it has better wearing qualities than natural ice and may be resurfaced easily and inexpensively. Exceptional durability and fast glide are characteristic. Furthermore, it is harmless to person and clothing. Its standard color is a light water green but other colors may be supplied.

Baked Aluminum

A BAKED aluminum finish of exceptional beauty and resistance is a new development in industrial finishing. Called Heresite A 313, it is made by Heresite and Chemical Company. The appearance is that of tarnished silver and it is, therefore, attractive for household devices such as radiators, pipes, washing machine parts, refrigerators, and many other types of apparatus such as auto heaters, fans, blowers, airplane parts, and the like.

The new finish has excellent adhesion and high resistance to mechanical abrasion and weathering. It is said to have withstood successfully 450 hours of continuous exposure to salt spray, a test that would badly injure an ordinary coating.

New Power to the Farm

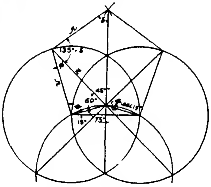
WITH new two- and three-plow tractors, today's small acreage farm can be completely power equipped for less than \$1500. The new small models will mechanize 3,000,000 more farms, it is estimated, and will supplement larger tractors on 3,000,000 bigger farms.

Tractors are rapidly attaining higher standards of engineering and refinement. More powerful and economical to operate, trimly streamlined, with self-starters, enclosed cabs, rubber tires, and other appointments, they are replacing older models.

Solution to the Problem of the Pentagon

LAST of Lieutenant Commander Kaplan's series of 14 problems, beginning in the April, 1939, number, skipping to the September number of the same year, and appearing regularly thereafter in this department until last month, has the following solution.

Consider the triangle shown in the sketch,



whose angles are θ, φ, and 60°. From the sine law, we have

$$\frac{\frac{r}{2}\sec 15^\circ}{\sin\varphi} = \frac{r}{\sin 60^\circ}$$

which reduces to

$$\sin\varphi = \tfrac{1}{2}\sec 15^\circ \sin 60^\circ$$

or

$$\varphi = 26^\circ\text{-}38'\,02''$$

Adding this value of φ to 60° and subtracting from 180° gives

$$\theta = 93^\circ\,21'\text{-}58''$$

and

$$\theta + 15^\circ = 108^\circ\text{-}21'58''$$

which is the value of the angle of the pentagon at either extremity of the base.

Completing the solution of this triangle, we have

$$\frac{z}{\sin\theta} = \frac{r}{\sin 60^\circ}$$

Taking next the triangle whose angles are ϑ, 45°, and 135°—ϑ, the sine law again yields the relation

$$\frac{z}{\sin\vartheta} = \frac{r}{\sin 45^\circ}$$

Combining and eliminating z from the two equations,

$$\sin\vartheta = \sin 93^\circ\text{-}21'\text{-}58'' \sin 45^\circ \csc 60^\circ$$

and

$$\vartheta = 54^\circ\text{-}37'\text{-}47''$$

Two other angles of the pentagon will have a magnitude, each of

$$135^\circ - \vartheta + \varphi = 107^\circ\text{-}02'\text{-}15''$$

and the angle at the top will be

$$2\vartheta = 109^\circ\,11'\,34''$$

The construction is not exact, and is in error by the amount the angles fall short of or exceed 108°.

The pentagon problem shows a construction for a regular pentagon, which is attributed to Albrecht Durer, German painter and engraver, who lived from 1471 to 1528. It is not an exact construction, but it is a very good approximation. The method of executing it is so simple and practical that none of its accuracy is lost in the process.

FIRST of Lieutenant Commander Kaplan's now completed problems were the five proposed in the April, 1939, number, page 219, these being entitled The Problem of the Crossed Ladders, The Problem of the Spheres, The Problem of the Barge on a Rock, The Dog and Rabbit Problem, and The Second Dog and Rabbit Problem. More problems were published as follows:

September, 1939, page 171, Problem of the Circular Pasture.

October, 1939, page 236, Problem of the Cylinder.

November, 1939, page 301, Problem of the Weights.

December, 1939, page 361, Problem of the Swimming Dog.

January, 1940, page 42, Problem of the Square.

February, 1940, page 110, Problem of the Chord and Arc.

March, 1940, page 173, Problem of the Medians.

April, 1940, page 237, Second Circular Pasture Problem.

In every instance except the first, the solution to these problems was published in the number following the dates stated above.

YOUR FIREARMS
and FISHING TACKLE

Conducted by A. D. RATHBONE, IV

INTEREST IN FIREARMS is traditional with American men, fishing tackle is a requisite of one of the world's oldest occupations Scientific development of guns and tackle, in the use of which millions yearly find sport and recreation, fathers this monthly department, which welcomes correspondence from readers

WELCOME, FISHERMEN!

GENTLEMEN of the angle, we welcome you to this gathering place of nimrods and fishermen! With this issue, the gun fanciers move along on the bench to make room for their brother sportsmen, the clan of rod and reel And yet we strongly suspect that many of you who have been visitors to this monthly round table on arms and

ammunition need but to glance in your shaving mirror of any morning to find simultaneously the reflection of both an angler and a hunter

We take our sports in season, we Americans, and come fall or winter, we think of upland game and deer, of wildfowl and indoor range targets When spring, with her outdoor stimulus, bursts upon us, our thoughts may stray from the category of trajectories, loads, long shots with scatterguns and the reverberating roar of indoor pistol and rifle fire to realms piscatorial. True, the shotgun enthusiast comes into his own with the nice weather and the flight of skittering skeet and trap targets Outdoor ranges are active, woodchucks must be wary indeed to avoid the ardent rifleman, but many a gun addict is lured from the smell of powder by memory of Izaak Walton's immortal, "Oh, sir, doubt not that angling is an art. Is it not an art to deceive a trout with an artificial fly?"

All these occupations have come to be parts of our lives largely through scientific development and research Without science, the knight of the bowing rod and the devotee of the trigger would alike miss many of the pleasures which are their's. Accordingly, from now on this department will strive to offer to both hunter and fisherman news, developments, and controversial grist for their respective "hot stove" mills Welcome, fisherman! Hail, gunner!

IN THE SPRING—SKEET

TO Mrs Gertrude Hurlbutt, Montana rancher's wife, went a $100 prize in 1926 from *National Sportsman* and *Hunting and Fishing* magazines for christening their newly sponsored shotgun sport "skeet"—Scandanavian derivation, meaning, "to shoot To arms and ammunition makers, clothing manufacturers, silver smiths and the U S Treasury have, since then, gone annually hundreds of thousands of dollars for guns, shells, 'birds," traps, shooting jackets, uniforms, insignia sportswear, cups and other trophies, and Federal excise taxes on shotguns and shells To innumerable fields and clubs go regularly 80,000 skeet devotees of all ages, both sexes, in any kind of weather, from humble homes and magnificent mansions, to 'shoot a round of skeet '

Evolved in 1915, introduced in 1926, skeet's still sky rocketing popularity continues to please its sponsors, delight gun and munitions people, contribute its share of Uncle Sam's special taxes, and intrigue new competitors From modest and scattered inceptions at Ballardvale, Massachusetts, Edmonds, Washington, and Valhalla, New York, skeet clubs are numbered in

Captain Grant Ilseng

thousands, have attained to sumptuousness and social status of country clubs, number among ultra - democratic memberships butchers, bakers, candlestick-makers, who contest shoulder to shoulder with bankers, executives, auto manufacturers International accolade has been accorded skeet by adoption in Belgium, Canada, England, Egypt, France, Germany, Norway, Sweden, South Africa, South America Credit for skeet's universal appeal goes to its sportive

Courtesy Abercrombie and Fitch

Skeet guns

competition, its year-round opportunities to duplicate field shooting conditions for practicing bird hunters, the inherent desire to fire a gun, and the never outgrown, adolescent thrill derived from deliberately smashing something

Named Captain of the 1939 All-American skeet team, big, blonde Grant Ilseng hails from California, participates in tournaments all over the map, holds such titles as the Great Eastern 20-gage, the California State 20-gage, small gage, and high over all, and boasts a season's all-gage average of .986 on 1550 targets Illustrative of types of guns which will powder millions of birds in 1940 are the Marlin Model 90, "Skeet king," over-and under, the Winchester Model 12, repeater, the Francotte Model 25, double barrel; the Remington "Sportsman" automatic To benefit skeet neophytes, "Bob" Nichols, *Field & Stream* firearms editor, has exhaustively covered the subject in his book, "Skeet, And How To Shoot It"

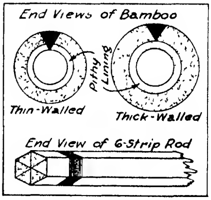
WHO'LL RAISE THE CANE?

IT'S possible that your favorite trout, bass, or salt water fishing rod traveled much farther before it came into your possession than it has since, for Tonkin cane, that sturdy, virile, properly flexible backbone of America's choicest rods, is grown in China The Waitsap area, near the borders of Kwangtung, Kiangsi, and Hunan provinces, some 175 miles north of Canton, is probably the birthplace of your favorite rod Although bamboo grows in many sections of the tropics and subtropics of both hemispheres, none of the growths offers the necessary rod-making qualities found in cane from the Waitsap area, where climatic conditions produce almost perfect bamboo, Calcutta cane advocates notwithstanding, and where our future delicate "fishing poles" are known locally as "tsing lee poles"

For many years Tonkin cane was systematically harvested by the Chinese populace and carefully seasoned in enormous compounds, comparable in an Asiatic way to American lumber yards It was then rafted down the Bambus River to Canton, transferred to Hong Kong-bound river boats, then re-loaded again for its transpacific voyage. Today, however, to a large extent, the Chinese have been driven out of Waitsap and the Japanese govern the land where grow our future split bamboo rods. Reports differ as to harvest, and, consequently, as to imports of Tonkin cane under present circumstances. One importer claims no Tonkin is being cut or stored A well-known rod manufacturer says that although Tonkin is popularly supposed to have ceased coming into this country a year or two ago, the Japanese now control the entire crop, employ Chinese labor, and that thus far there has been enough on hand to supply the makers of high-grade rods Be that as it may, there seems to be agreement on the score that our future supply of Tonkin cane could and may be threatened

When the much traveled Tonkin cane gets into the hands of the good rod manufacturer, it is split, not sawed, because, by splitting, the natural grain of the wood is followed and a stronger rod results If you were to cut a section out of your rod, you would probably find it composed of six triangular strips of bamboo, neatly matched as to similar grain, and, if it's a really good rod, the inside apex of the triangular pieces of split bamboo would be hard and firm, like the outer edge Without this stout heart, your rod would be flimsy and spineless To avoid such wilting action, manufacturers of quality rods use only butt pieces of Tonkin in which the bamboo wall is of sufficient thickness to permit splitting the triangular strips without encroaching on the pithy lining of the cane

Having mentioned that you would probably find your rod composed of six triangular strips, it's apropos to state that this type of construction is used by rod manufacturers today after exhaustive tests and because it has proved most satisfactory throughout tho years Behind the adoption of the six-strip rod, however, lies a brief history of



Top sections show why thick-walled cane is best for rods Lower drawing How rod sections are fitted

these fish begetting instruments. In 1847, a Mr Little, of 15 Fetter Lane, London, and rod maker to his Royal Highness, Prince Albert, began making rods from "three rent pieces" Thomas Aldred, another Londoner, inaugurated his three-strip process about the same time An Easton, Pennsylvania, gunmaker, Samuel Phillipi, brought out a four-strip rod in 1862, and was followed eight years later by H. L. Leonard, of Bangor, Maine, with a six-strip construction. The well known Hardy Brothers, of Redditch, England, offered their six-strip rod in 1882.

But getting back to present-day methods of rod manufacturing· Nodes, which are the regularly spaced knobby parts of the bamboo, are staggered in assembling the triangular strips so that no two nodes will

come opposite each other. When strips are split for rod construction, these small areas of tough cross grain must be spaced so they will alternate in any given section. And speaking of sections, rod makers cannot emulate the assembly line of auto manufacturers They do not build a supply of butts, pick up any mid-section from the rack, and end up with a casual tip, or tips. No, sir! When you buy your trout rod from your favorite dealer, you may rest assured that if it bears the name of one of America's leading manufacturers, it has been properly matched as to grain, and that it is the product of a careful "tailor made" process Like wise, the strips have been selected with an eye to exact fit at each ferrule, so that it has been unnecessary to cut down the bamboo to attach the ferrule

As to which rod, how long, what weight — that's a story in itself The decision rests on many things, including type of fish, lake angling or stream fishing, and the size of the latter Are you going to fish fresh water or salt seas? Will it be wet or dry work for trout? Or is it salmon? And it can be bass, pickerel, panfish An outstanding factor is the preference of the fisherman, himself toward the "feel" of a rod Nevertheless, you can't go wrong on a product of any of the several widely known American manufacturers, each of whom offers extensive and expert advice on rod selection and a satisfactory variety from which to choose

"All-American" Trout Flies

THERE is probably no more controversial subject among anglers who use artificial lures than, "Which are the best flies?" A year ago *National Sportsman* printed one of our stories entitled, "What Fly, Mr Fisherman?" and accompanied it with a ballot and an invitation to the nation's trout anglers to designate their choices They were asked to name the six dry flies, six wet flies, and six streamers or bucktails they had found most productive The poll drew replies, some most emphatic, from 23 states and named 319 different patterns Using a point system of scoring, it was found that Royal Coachman was the decided favorite in both dry and wet classifications The idea back of the story and its sequel (*National Sportsman*, March, 1940) was to attempt to simplify the perplexing problem of selection of trout lures, of which there are over 10,000. We figured that if enough of the country's trout fishermen told us which flies they had found most successful, we would have something to offer toward settlement of that ever ponderous question

With that in mind, we sent the completed data to The Weber Lifelike Fly Co., who promptly furthered the idea by printing a folder depicting both national and regional results of the survey They capped this by packaging "The All-American Fly Selection," incorporating the six winners in each of the dry, wet, and streamer-bucktail categories within one box. Now we don't for a moment contend that possession of a set of "All-American" flies is a panacea for all trout fishing ills, and neither does Weber Like the choice of a rod, individual preference and experimentation will, within certain sensible limitations, ultimately determine which flies you like best. As one voter in the survey so aptly put it, "The manner in which the lure is presented and worked has made many a poor lure productive and many a good lure fruitless." However, several fishermen have told us that the survey helped, and if you'd like one of the Weber folders showing complete results, just let us know

Pot-Shots

AT THINGS NEW

W R ("Bill") Weaver, maker of that sensational 1-power shotgun 'scope, as well as the famous Weaver 330 and other scopes for small and large bore rifles, has announced a substantial reduction in the prices of his scattergun 'scope. This product has proved such a boon to beginners and to others who want to improve their shooting that the demand has increased to the point where production tools and quantity manufacture have become possible, thus bringing about the new price of $19 on the Type T mount, which formerly sold for $27 50 The type B mount, which used to sell at $31, can now be had for $22 50

When Kipling wrote, "Boots boots -boots —boots—movin' up and down again!" he, of course, had in mind the incessant tramping feet of an army, but the quotation could as well refer to the army of trout fishermen who slosh up and down the nation's streams and rivers Without a good pair of boots the trout angler is lost, There's nothing which so literally and figuratively dampens the Waltonian's ardor as the constant trickle of ice water into the rubber casing about his pedal extremities With that in mind, the Goodrich Footwear Division of the Hood Rubber Co, Inc, announces a new wader-top boot with light, flexible rubber legs extending well above the knees to provide longer wear and reduce danger of snagging Special fabric, coated with highest grade rubber compounds, is used in body portion for lightness, flexibility, and long wear Another feature which will be welcomed by every angler who has at some time slipped and gathered himself a bootful of water is that these waders can be turned completely inside out, right down to the insole In a unique pamphlet called, "Fishing Facts and Fancies," the Hood people display all their wares and offer some authenticated "tall" tales, such as the one about the catfish found in a tree, 40 feet above ground, the salt water denizens of New Hampshire's fresh water lakes Drop us a card and we'll send you a copy

Ithaca Gun Company announces a new member of its popular "Model 37" family New arrival is Ithaca Model 37R, a repeater, available in 12 gage with 26, 28, 30, and 32 inch barrels; in 16 gage with 26, 28, and 30-inch barrels; in 20 gage with 26 and 28-inch barrels, all with any standard degree of choke Outstanding feature of Model 37R is "dead level" solid, raised rib with no dip, no sway, no ramp to interfere with true sighting plane. The "dip" found at rear end of sighting rib on several makes of popularly termed "rib-shotguns", causing difference in height between top of rib and top of frame, has been eliminated in Ithaca's Model 37R, thereby establishing absolutely straight sighting plane from the breech to the very muzzle of the barrel

Conducted by JACOB DESCHIN, A.R.P.S.

Aping the Masters

"GEE, I wish I could light a subject that way," is an expression one often hears from amateur workers as they admire the pictures of professional photographers. The fact is that the difference between professional and amateur lighting is largely a matter of volume, although other factors must be taken into consideration, such as a difference in subjects and make-up, the fact that professional lighting results are frequently aided by after-work on the part of the retoucher, and a difference in the quality of the light provided by professional equipment and that available to the amateur worker

Acting on the suggestion of Norman A Schuele, an enthusiastic amateur photographer and Advertising Manager of Revere Copper and Brass, Inc., we recently interviewed Bruno of Hollywood, and then retired to our own modest studio to see what could be done about it Bruno, as you may know, is a specialist in the art of movie

Virginia Wilson
By Bruno of Hollywood

glamor In his studio in New York, he is known as the man who makes them "look like Hollywood" even when they "come in looking like New York" He achieved his national reputation while in Hollywood, where he made a specialty of photographing stars and would-be stars The technique that he employed in this work he brought with him to New York

Mr Bruno has been kind enough to permit reproduction of two of his pictures as examples of the "straight" and the "glamor" techniques he employs The picture of Lorraine O'Day is an example of the first, and that of Virginia Wilson, of the second. The latter had the simplest lighting· a 1000-watt spotlight directly overhead and a 1000-watt diffused floodlight far back in the room The distance of this latter light must be adjusted to provide just that amount of light that will suitably fill up the shadows without interfering with the lighting effect provided by the spotlight An approximation that may be employed by the average worker is shown in our illustration, in which a Photoflood type spotlight was used overhead and a No 1 Photoflood bulb in a Kodaflector set back of the camera at an angle of about 30 degrees to the subject Little attempt was made to duplicate the Bruno picture except as to light placement Since it is not usually practical for the amateur to use a spotlight directly over the subject, the spotlight used was directed overhead as nearly as possible

The Lorraine O'Day portrait was lighted in considerably more complicated fashion Two 1000 watt flood bulbs were placed six feet from the subject at an angle of 45 degrees to the latter and eight feet high A 1000 watt floodlight was placed at the same angle on the other side of the face but lower and twelve feet away A 1000-watt spotlight was used for the head and a 2000-watt spotlight illuminated the background In our example, we substituted two No 1 Photofloods for the light six feet from the subject, but because an eight-foot extension was not available we used one about 6½ feet high For the shadow side light 10 feet away from the subject, we used a No 1 Photoflood A Photoflood-type spotlight was used instead of the 1000-watt spot used by Mr Bruno and for the background we used a No 1 Photoflood illuminating a monkscloth background

An exact reproduction of the lighting as seen in the print cannot, of course, be claimed for our examples, because, in addition to the necessarily more efficient light-

Virginia Wilson lighting

ing units of the professional, there is also the factor that the professional's prints were made by contact instead of the enlarging method usually employed by amateur workers these days, and also because the professional's prints must usually be retouched, at least in a moderate way

Our thesis, however, is based on the fact that, although necessarily modified because of difference in lighting equipment, the amateur worker may copy the lightings of the professionals and successfully achieve

Lorraine O'Day
By Bruno of Hollywood

the lighting effects of the latter Chiefly, it is a case of light placement and light volume Professional lighting effects can be studied and the various lights identified by studying the shadows cast by the subject's nose, lower lip, chin, and so on Practice of this kind will help you to arrange your lightings and to achieve satisfactory illumination of your subjects

Dentists and Photography

THE part played by photography in the professional as well as the leisure life of the dentist was surveyed in the March issue of *Dental Survey*, in which it is stated that "thousands of dentists are numbered among the most enthusiastic camera fans to be found anywhere"

"Photography has a particular appeal for the dentist," the article says, "for through it he can make a hobby serve him as a tool in his daily work Pictures can be used to the greatest advantage in patient education as a simple, effective means of showing the importance of dental care. Projection of slides brings home lessons that the dentist can never inculcate by demonstration or word of mouth The patient's own case can be personalized in a way that wins him at once to the necessity of adequate treatment

"One dentist has made an album of 'before-and-after' pictures which he uses to demonstrate to patients what different types of restorations will do for them by the improvement that has been accomplished for other patients.

"Color photography has recently come into its own and now enables dentist photographers to achieve even more remarkable results. With the still camera it gives them the most accurate record of the stages of their important cases. The method of treat-

Lorraine O'Day lighting

ment can be followed with the motion picture camera, operated by an assistant, and in the class room, at clinics and dental meetings, motion picture photography in color helps spread undergraduate and post graduate education by demonstrating in practice what has already been studied in theory"

Apartment House Darkrooms

THE vogue that started in New York City some time ago of providing apartment house tenants with community darkroom facilities has gained considerable headway The latest innovation is the provision of fully equipped darkrooms for the East Side apartment house dwellers living in the buildings owned by the Tishman Realty & Construction Company

"Each building," *The Foto Review* reports, "will be equipped with a spacious darkroom designed to appeal to both beginners and advanced amateurs The room, mechanically ventilated, will be supplied with modern equipment, including stainless steel sinks, two enlargers, printing machines, developing tanks and trays, safe-lights, timers, trimmers, scales, and graduates to assist in the production of good photographs"

Avoid Ridicule

IF some amateur does poor work because he cannot do better just yet, be chary of ridiculing him, he may outstrip you later In any event, there is neither charity nor good taste in making fun of the work of one's associates in the camera hobby Yet it has come to our attention that in at least one club the pictures of one worker were laughed at when exhibited to the club members, to the great discomfort of the worker concerned One member, not the victim, was so upset by this attitude of the club members that he resigned What if his turn should come next?

There is no doubt that a general club is bound to have a number of members who are rank beginners and turn out what may appear to be astonishingly poor stuff when compared with the work of the more advanced members. However, the advanced members need only look back a few years and recall how bad their first efforts were

But it is easy to forget. A person joins a camera club to get help and not to be laughed at every time he makes a false step. Helpfulness should be the motto and no club will be worth anything at all unless, instead of laughing at the mistakes of individual members, the better and more experienced workers volunteer advice that will set the erring worker on the road to better picture-making

Visitors' Picture Album

SAMUEL E LESSER, New York, submits what he believes to be a new idea in picture making and picture collecting He writes:

"I am in process of making 8 by 10's of pictures of all my friends who visit us, and relatives and other people who enter our lives more than transiently When the whole is completed (which may take a year or so), I shall bind them up in a permanent book of record Really the old-family album streamlined for modern purposes"

Pictures at the Circus

THE availability of extreme speed films makes indoor circus shots more feasible than formerly It is now possible, under spotlighting effects, to shoot as fast as 1/100 and 1/200 of a second at $f/3.5$ or $f/4.5$. The accompanying illustrations were made with an $f/2.9$ lens wide open at 1/200 of a second, although the results showed that a higher shutter speed or smaller lens opening could have been used if desired The exposures were made about 50 feet away from the camera and the wanted section enlarged to 8 by 10

In the case of acrobats "flying" through the air, we found a handicap in the fact that the spotlights were turned off during the action, doubtless in order not to handicap the performer, and turned on again when the subject reached the other side Of course, such subjects have to be left alone because there is not enough light available during the flight to make an exposure possible at the short shutter speed necessary

Many subjects do not require fast exposures, however, and may be taken as slow as 1/25 and 1/50 of a second Also, even fast action may be "stopped" if the shot is made just as the subject reaches his objective or when he is momentarily suspended

"Watching the Prey"

"Mid-Air Stunting"

in space before coming down again This calls for careful watching and quick shooting The shot of the acrobat in the five-man somersault, for example, was made just as the subject reached the shoulders of the fourth man in the "human ladder," after jumping from the spring board below The shutter speed was 1/200 (the fastest the camera possessed). If a faster shutter speed

"Five-Man Somersault"

were available, 1/500 would have been attempted as the man was flying up, although 1/1000 would probably be necessary.

Pictures such as "Watching the Prey," which shows a tight rope walker performing while news photographers sit around waiting for an opportunity to make a startling shot, may be had at 1/50 of a second and even slower

Kodak at 1940 Fair

ESTIMATING a total attendance of nearly four million visitors during the World's Fair in 1939, the Eastman Kodak Company has announced extensive improvements on their Fair Building for this year that are expected to attract an even greater attendance, according to Kodak officials. Among the changes are a complete new front and an enlarged entrance foyer to the Great Hall of Color; a special salon in the Hall of Light for the continuous and elabo-

rate presentation of the Kodak style show; "startling tricks in photography, along with other thrilling demonstrations" to be presented during the fashion show intermissions, the addition of two model living rooms in one of which will be projected full color home movies and in the other "still" pictures in natural color, changes in the photographic gardens, as well as other improvements

Camera Clubs Grow

At last we have been able to obtain a figure closely approximating the number of camera clubs in this country. After an extensive survey, the Eastman Kodak Company has found that this total comes to 9000 Adrian TerLouw, who kindly passed this information on to us, added however, that this was only the known total and that the actual number exceeded this considerably Clubs are springing up all the time and many active groups do not announce themselves as clubs, preferring to remain "incognito"

New Background Cloth

Photographically useful materials are frequently to be found in other than strictly photographic stores, as our readers have doubtless found out for themselves from time to time and as we have occasionally intimated by announcements in these columns One of our latest finds is a cloth material known as Inca, which we understand is being widely used by professional photographers where large backgrounds are required This material, the color of which is a light tan or cream, comes 9 feet (108 inches) wide and sells for only $1 75 a yard

Technical Adviser

Formerly instructor at the New York Institute of Photography, with many years of both professional and teaching experience, Morris Germain, A R P S has been appointed Technical Adviser for the Penn Camera Exchange, New York City Mr Germain's task is to assist the store's customers in their photographic problems and in the use of equipment

One of the features of Mr Germain's association with the store is a series of talks

Photo by Saul Germain

Where serious amateur photographers may learn from a professional

on various phases of photography. The opening gun was fired recently when Mr. Germain gave a talk on the fundamentals of lighting in photography. An index of the popularity and helpfulness of Mr. Germain's talk is the fact that the lecture had to be repeated a week later to accommodate the overflow of visitors who had to be turned away the first time for lack of space. The accompanying illustration shows a section of the audience, as flashed by Mr. Germain's son, Saul Germain, a journalistic photographer. With Mr. Germain on the platform is Miss Ilse Hoffmann, who served as Mr. Germain's model for the occasion.

WHAT'S NEW

In Photographic Equipment

If you are interested in any of the items described below, and cannot find them in our advertising columns or at your photographic dealer, we shall be glad to tell you where you can get them. Please send a stamped envelope with your request.

DUO SPOT-FLASH ADAPTER ($6.95). Designed to fit most makes of synchronized flash equipment, for exclusive use of G. E. No. 5 flash bulb ("Mighty Midget") in directed flash photography. Supplied with removable ring. With ring in reflector, angle of light is 50 degrees and claim is made that ordinary flash exposures can be achieved at about same speeds and apertures ordinarily used with larger standard bulbs such as G. E. No. 21 and Wabash Superflash No. 2. With diffuser ring removed, pictures can be made at distances up to 100 feet or more. Spotlighting possible because adapter is designed to use all available light as directed beam rather than normal flood. Reflector designed to project beam of light having approximately 30-degrees spread. Diffuser ring redirects part of beam over wider angle of approximately 50 degrees.

KALART CONCENTRATING REFLECTOR ($1.95). New type concentrating reflector designed for use with new midget bayonet base flash bulbs. Furnished complete with built-in ejector. Said to double light efficiency of bulb. Guide stem keeps reflector in correct position so that light will be properly directed. Reflector made of spun aluminum with highly polished reflector surface. Bayonet base bulbs automatically centered when placed in socket. Reflector may be used with battery cases of all makes.

PERFORATED PAPER ENVELOPE. Defender now packaging all photographic papers in new, easy opening envelope. Envelopes made with double perforation across flap of envelope; mere rip and tear gives quick access to contents. Perforated opener available in all sizes up to and including 11 by 14 inches.

BEE BEE FOLDING POCKET SUNSHADE AND FILTER HOLDER ($2.50). Compact, adjustable sunshade with provisions for mounting filters. Springs open instantly at touch. Adjustable feature allows use of one sunshade and one set of filters on more than one camera. Available in four sizes, as follows: No. 1 fitting lens rims from 19mm to 26mm diameter, mounting 34mm filters, closed, 1 3/4 by 2 1/16 by 1/2 inches, opens to 1 7/16 by 2 1/16 by 1 9/16 inches. No. 2, fitting lens rims from 26mm to 33mm, other specifications same as for No. 1. No. 3, fitting lens rims from 33mm to 39mm, mounting 46mm filters, closed, 2 1/8 by 2 9/16 by 1/2 inches, opens to 2 1/8 by 2 9/16 by 1 15/32 inches. No. 4, fitting lens rims from 39mm to 45mm, other specifications same as for No. 3.

ARGOFLEX TWIN LENS REFLEX CAMERA ($35, complete with leather carrying strap, all leather carrying case $5 extra). Takes 12 pictures size 2 1/4x2 1/4 inches on standard 8-exposure roll. Viewing lens and objective lens identical 75mm f/4.5 triple anastigmat, color corrected. Shutter speeds from 1/10 to 1/200 of a second, time and bulb. Built-in sunshade. Direct vision finder for eye level action. Highly polished first surface reflecting mirror. Depth of field scale.

NEW MODEL MCM PHOTOMETER ($4.85). New type direct reading automatic dial requiring no manual adjustment. Does not have to be preset for different paper speeds. Sensitivity "booster" increases visibility of spot, permitting faster and more sensitive adjustment, particularly in dark areas, and makes user view spot from same angle.

SCROLLETTE ADJUSTABLE PICTURE HOLDER (Jr., $1, Sr. $1.50). Self adjusting picture holder that does away with ordinary picture frames. Can be used horizontally or vertically as table easel or hung on wall. Made of genuine phosphor bronze and available in natural polished finish or satin chromium. Made in two sizes. Junior holds any picture from 6 to 9 inches, Senior from 10 to 14 inches.

BURTON FRESNEL SPOTLIGHT ($7.95, bulb extra, 85 cents). Housing molded of Bakelite. Stand of heavy cast metal, equipped with four rubber legs and tripod attachment. Head removable from base, can be used separately. Where height required, can be used with light stand or tripod. Optical system consists of two inch Fresnel lens with cylindrical diffusing glass in adjustable mount with highly polished reflector.

NEW CYKON, CYKORA SURFACE. Designated as Matte White, is neutral white and provides smooth, even surface devoid of sheen or texture. Suitable for pictorial views, landscapes, portraits, still life, and other subjects. Available in three grades in both Cykon and Cykora emulsions.

CHARDELLE METEOR-FLASH SYNCHRONIZER (complete with one tip, 14-inch cable, and torch unit plus calculator, $9.95). Mechanical type unit, precision made. Manufacturer's claims smooth-operating, guaranteed not to impair action of even most sensitive camera shutters. One of chief features is automatic, safety retractable plunger permitting Meteor-Flash to be set for next exposure before shutter is set, and vice versa, plus following 5 1/2 inch aplanatic adjustable polished chrome reflector; powered by two No. 925 Eveready batteries; quick change, sure contact socket; synchronization at any shutter speed and with any bulb, fully reliable, exposure calculator (recently reviewed in these

columns) furnished, with official Weston film speeds, molded rubber cables, no soldered connections, interchangeable tips with quick-change features for practically all cameras, indestructible silver wiping contacts, all materials and workmanship guaranteed Accessories interchangeable tips, four and eight-foot cables (20 foot cables available later), connector block for multiple flash, clamp tripods to hold camera or additional flash units, additional torch units, various brackets to fit wide selection of cameras. Weight torch unit, including battery and reflector, 13½ ounces, switch unit, 1½ ounces; cable, ¾ ounce Over all length of switch unit, including tip, 3⅛ inches, over all height of torch unit, exclusive of reflector, 6¾ inches

Britelite Triple Duty Screen (Size 30 by 40 inches, $10, 40 by 40, $12, 36 by 48, $13.50) · May be used in standing, sitting, or hanging position Comprises three units three piece tripod extending to 6½ feet, beaded screen with black masking border contained in map case with welded L bracket, rod which permits screen to be placed in standing position on table or other support (hanging position of screen from standing to sitting or hanging accomplished in few seconds

Fedco Adjustable Developing Tank ($1.85) Features Red Top cover which locks securely on inside, thus making it light-tight. Pitched spiral loading reel, provided with metal prong which catches center core, holds reel firmly in place, giving correct size for film being developed, and prevents film from slipping or sliding Furnished with tank is combination thermometer-agitator, provision made for inserting it into center core Tank durable and chemical-resistant, stainless steel and molded Bakelite Spiral reel adjustable to all sizes film from 35mm to size 116

Mercury Copying Stand ($17 50) Permits Mercury camera to be used conveniently for photographing small objects or flat work at close range Principal parts include baseboard with vertical support tube at one end, arm for supporting Mercury camera with lens facing down towards the board, set of extension tubes for bringing lens into focus at close range, ground-glass focusing screen Four extension tubes and shim available which may be used for photographing fields from 9 by 11½ inches down to 5/8 by 31/64 of an inch. Tubes may also be used in combinations Arm adjustable up and down on tube and may be rotated Camera holding bracket may be moved up or down on arm by means of micrometer screw.

Eastman Film Kodaguide (10 cents) Provides data on all Eastman sheet films, miniature films, roll and pack films in general use. Data include identification of film type, color sensitivity, Kodak speeds, Weston and General Electric meter settings both daylight and tungsten, notching code chart, chart showing monochrome rendering of colors by each film type under tungsten light, and daylight and tungsten factors for eight commonly used filters (K-1, K-2, X 1, G, A, F, B and C-5) when used with each film type. In addition, spectrograms of all film types and spectral transmissions of all filters charted in full color.

CAMERA ANGLES ROUND TABLE

JACOB DESCHIN, conductor of our "Camera Angles" department, will answer in these columns questions of general interest to amateur photographers. If an answer is desired by mail, enclose a stamped, addressed envelope. Queries should be specific, but Mr. Deschin cannot undertake to draw comparisons between manufactured products nor to advise on the purchase of equipment or materials.—The Editor.

Q. I have been fooling with depth of focus indicators and find my calculations at variance with all the cameras I have tried. Is there some difference in the spread of a scale for a camera lens from that of a thin lens of the same focal length?—J. M. P.

A. By "spread of a scale" we presume you mean depth of field for any given lens stop and object distance. The depth of field is dependent on the circle of confusion or the degree of definition, as you know from your calculations, on the focal length of the lens — the greater this is, the shallower the field, on the size of the lens stop and the distance of the object focused upon. Lens thickness or thin-ness is not a factor.

Q. What is "metol-poisoning," its symptoms, and how may it be prevented? How effective is colored cellophane as filtering material?—T. R.

A. A skin irritation experienced by some photographic workers when handling solutions containing metol or a similar chemical. Local irritation and cracking of the skin are the symptoms. Washing hands with soap and warm water after handling chemicals and solutions, and the wearing of rubber gloves, are the best precautions. It is said, however, that not more than 1 out of 500 persons experience trouble from this source. Colored cellophane might be used as filtering material over light sources but is not advised for use over the lens.

Q. For some time I have been interested in casting plaques in high relief in plaster. Is there a practical photo relief method?—W. L. H.

A. A method of photo relief practiced by a Professor Namias and described by E. J. Wall, in his "Dictionary of Photography" follows. "An ounce of fine gelatine is soaked in 3½ ounces of water, and the vessel is heated in a water bath until all is dissolved, after which 1 fluid drachm of glycerin is stirred in. The mixture, having been strained through fine muslin, is poured on leveled glass or metal plates, 1 fluid drachm being allowed for three square inches of surface. When dry the coated plates may be kept any length of time, and sensitizing is performed by soaking a plate for 15 minutes in a 6 percent solution of ammonium bichromate, and drying in the dark. Exposure under a negative in the printing frame should be continued sufficiently long to give a fully detailed image in brown, the time required being about the same as would be involved in making a print on ordinary print-out paper. On soaking the exposed plate in water the relief is produced, and the plate can be moulded with plaster or with a waxy composition upon which an electrotype is made. If the swelled relief be very gently heated there is such a redistribution of the gelatin as makes the relief persist after the gelatin stratum is dry."

Q. I would like to know where to obtain data on the printing of color films suitable for submission to magazines. Any information you have available as to the type of print suitable for printed reproduction will be appreciated.—L. B. K.

A. Magazines will accept Kodachrome and Dufaycolor transparencies from miniature sizes up for purposes of reproduction. As you know, in both instances processing is done by the makers of the films, in the case of Dufaycolor this may be done by the photographer. Keith Henney's book, "Color Photography for the Amateur," describes the various methods of color printing and the recently published "Photographing in Color," by Paul Outerbridge, an outstanding worker in color, will give you all the information you need.

Q. I tried developing my first roll of film in a tank and found only one negative came out. This negative was in the middle. The ones at the beginning of the roll were completely clear of any sign of pictures while the ones at the end of the roll had signs of appearing. Also, when I am printing, a patch of brown appears on about 90 percent of my prints. Could you tell me the cause and the correction?—G. F.

A. Undoubtedly, the blanks on your roll of film were due to extreme underexposure, or failure of the shutter to operate. The ones at the end of the roll had evidently received a brief exposure but too short to provide a useful image.

The brown patches may be caused, among other things, by dirty dishes or measures, or improper fixing. In the latter instance, this may be due to failure to keep prints moving in the fixer and to keep them submerged in the bath.

OUR BOOK CORNER

THE Book Department of Scientific American is conducted, with the co-operation of the Editors, to make available for you a comprehensive book service. Each month the Editors select and review in these columns new books in a wide range of scientific and technical fields. In addition, they are ready at all times to advise you regarding the best available books on any subject. You are invited to use this service freely. Tell our Book Department what kind of books you want and you will be furnished with a list of available titles, including prices. When inquiring about books, please be specific; remember that we can be of the greatest help only when you tell us just what you are looking for.

THE CYCLOTRON

By W. B. Mann, Ph D, Univ of London

COMPACTLY, this little book explains the cyclotron in language neither popular nor abstruse but intermediate, suitable for readers who remember some part of their physics (92 pages, 4 by 6½ inches, 31 illustrations) - $1 60 postpaid - *A G I*

PAPER CHASE

By Alvin F. Harlow

SOME philatelists collect those little colored bits of paper for one reason and some for another An artistic eye sees their art, a mercenary eye their money value, while to some people stamp collections merely represent evidence of the acquisitive spirit No matter in what category the collector or would-be collector belongs, this new volume, subtitled "The Amenities of Stamp Collecting," tells about all there is to know of the history of stamps, of philately, cancellations, processes of engraving, kinds of collections that are and can be made — and all in so lively and interesting a vein that even the rankest amateur will find it good reading (353 pages, 5¾ by 8½ inches, numerous illustrations) — $2 85 postpaid — *F D M*

SCIENCE FOR THE WORLD OF TOMORROW

By Gerald Wendt

DESIGNED for the reader who would like to survey quickly the whole broad field of science and consider briefly the applications of science to his everyday life, this book affords a superficial but interesting source of information The writer has skimmed the surface and, in his own words, "looks forward to the world of tomorrow by trying to understand the forces which have produced the world of today" (316 pages 5½ by 8½ inches, a large number of photographic reproductions) $2 85 postpaid — *A P P*

FUR, FEATHERS AND STEEL

By Reuben R Cross

FEW men have been so fortunate as to accumulate the mental storehouse of knowledge of things of the outdoors as has this author Fewer still have had the gift of words and the willingness of spirit to pass on some of this knowledge to their fellows In this volume, the author, who qualifies as woodsman, ornithologist, botanist, entomologist, hunter, and as one of the most far-famed tiers of trout lures, gives you his conception of the last named of his many arts Dedicating this, his latest book on fly-tying, "To those anglers who never become so engrossed in their art of casting and killing trout that they cannot pause to listen to the song of a warbler, or admire the beauty of a delicate wild flower," he tells and shows you how to concoct the most enticing and efficient lures from fur, feathers, and steel (78 pages, 5 by 7½ inches, 16 photographs, 11 line drawings) - $2 10 postpaid - *I D R, II*

THE BOOK OF DIAMONDS

By J. Willard Hershey

CURIOUS lore, properties, tests for genuineness, and synthetic manufacture are the things about diamonds treated in this rather more popular than technical work containing, nevertheless, a great deal of general diamond information (142 pages, 6 by 9¼ inches, illustrated) $2 10 postpaid — *A. G I*

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By G Gamow

SIX fantastic scientific adventures in which a noted physicist puts in racy narrative form the weird results of some of the modern concepts of the curvature of space, quantum mechanics, velocity of light, and so on Will vastly fascinate the whimsical, and is also entirely scientific Mr Tompkins, the hero of the adventures, finds himself in an odd, topsy-turvy world! (91 pages, 6½ by 8¼ inches, illustrated) $2 10 postpaid — *A G I*

RED LANTERNS ON ST MICHAEL'S

By Thornwell Jacobs

WE digress from science long enough to mention this novel by a close friend of Scientific American, Dr Thornwell Jacobs, President of Oglethorpe University, and originator of the noted Crypt of Civilization It is the epic story of a poor boy during the period immediately preceding the Civil War and progressing through that ghastly conflict It takes its title from old St Michael's in Charleston, South Carolina, as the story is set almost wholly in that state. Our verdict on this book is that it is an enthralling addition to the rapidly growing list of historical novels based on the Civil War era A departure from usual novel-publishing practice is the large number of reproductions of old woodcuts and drawings contemporary with the period covered by the story. — $2 60 postpaid

SEX AND LIFE

By Dr Eugen Steinach

IN which the noted Dr Steinach, summarizing his life work at 80, for the first time tells the popular reader about his method of rejuvenation through reactivation of the sex glands (the so-called "Steinach operation") and tells it in the form he prefers, rather than the often perverted form of the sensational press (252 pages, 6 by 9 inches, 67 illustrations) - $3 85 postpaid - *A G I*

THE TOOLS OF THE CHEMIST

By Ernest Child

THE subtitle of this volume, "Their Ancestry and American Evolution," just about describes its scope As is the case with most such books covering the long perspective, this is a fascinating outline of progress for all those even slightly interested in chemistry The ancient woodcuts and numerous illustrations showing processes enhance its value as a reference work One section is devoted to biographical notes on some famous distributors of apparatus (220 pages, 6 by 9 inches, numerous illustrations) — $3 60 postpaid *F D M*

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By Douglas Johnson, Prof of Physiography, Columbia University

A CRITICAL review of the several hypotheses that attempt to explain these odd geomorphological phenomena, with a detailed exposition of the author's hypothesis of submarine spring sapping (126 pages, 6 by 9¼ inches, illustrations) — $2 60 postpaid - *A G I*

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By John C Long

WITH the problem of preservation of democratic principles so acute, it is an invigorating experience to read of William Pitt's life long fight in the English House of Commons to re-establish those principles in Anglo-Saxon existence for all time The author dissects middle 18th Century British political life to depict Pitt's spurring influence on the lesser

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satellites of his time, a thoroughly democratic influence which resulted in reclamation of the Magna Carta "from the archives" In swift-moving, graphic manner, the author carries his subject from William Pitt, the boy, through his rise in Parliamentarian circles, his ascendancy to leadership in the Whig party, and through one of the great crises of his life, his victorious fight for freedom of the press (576 pages, 5¾ by 8½ inches, including notes, bibliography and index, with 41 illustrations and 9 maps) — $3.60 postpaid — *A D R, IV*

FAITHS THAT HEALED

By Ralph H Major, M D, Professor Pathology, University of Kansas

SEVERAL famous cases from history in which faith in a belief, sometimes religious, sometimes of some other type, brought about marked alterations in the affairs of large numbers For example, Lourdes, St Vitus, Pied Piper, Bloody Host, Abbess of Bingen, Healing Touch, Dowieism, Witchcraft Except for the possible implication involved in linking these together in one book, there is nothing that should irritate the religious The tone of treatment is simply narrative, factual, tactful and is entertaining throughout (290 pages, 5 by 8 inches, 30 illustrations) — $3.10 postpaid — *A G I*

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TELESCOPTICS

A Monthly Department for the Amateur Telescope Maker

Conducted by ALBERT G. INGALLS

THE opening part of the account which follows will be found on page 347, the purpose in dividing it between two parts of the magazine being to present there only the general details of the Goethe Link Observatory, such as are likely to interest all the magazine's readers, reserving the more technical parts for special followers of the telescope makers' department The author of the present account, Victor E Maier (1306 Parker Ave, Indianapolis, Ind.), is known to amateur telescope makers everywhere, for he has long been active in the hobby The 36" Goethe Link reflector is believed to be the largest telescope built by amateurs since this magazine gave an ancient but nearly extinct hobby its renaissance in 1926 by publishing an instruction book The old lines between amateur and professional telescope makers have largely dissolved Nearly all the great professionals were men who started small and, generally working by themselves, simply developed the art through character, perseverence, tenacity Few had much help Many amateurs among the thousands who had followed the hobby have now learned to do large work equally well and through the same approach The professional, who works at it all the time, can beat the advanced amateur in speed Some amateurs, because they do not have to make their living through the work, can afford to take more time, and thus have done better work than some professionals The description by V. E Maier continues

"The observatory stands on a high promontory 25 miles southwest of Indianapolis, near the small village of Brooklyn From it the Indiana terrain is visible for 40 miles The building is framed of oak posts and beams cut from the forests not far distant, 13 tons of steel beams were also used in construction, arc welding being employed wherever possible

"The designers of the observatory and its equipment have sought to include the best features of all the observatories, together with as many innovations as could be used profitably The design of the building itself was inspired by Russell W Porter, who generously sent one of his famous thumbnail sketches to Indianapolis Details were drawn up by A F Pittman, an Indianapolis 'TN' The larger hemispherical dome, 34 feet in diameter, is framed of wood fastened to a 12" I beam dome ring It rolls on tapered roller bearings, and is driven with an endless cable fitted with a unique shock-absorbing device The 34-ton dome is rotated adequately by a ½ h.p. electric motor The broad slot opening, nearly three times as wide as the mirror, permits easy manipulation between the dome and the telescope The zenith is accessible in any azimuth of the opening The shutters weigh one ton each, and are activated by push buttons and a ¼ h p. motor Dome and shutters are covered with interlocking sheets of steel terneplate and aluminum paint

"The 36" Goethe Link reflector has several features that are thought to be new The concrete pier was poured before the building was erected It is anchored to bed rock to prevent vibration or future misalinement The steel bearing boxes for the polar axis are bedded directly in the concrete, making the pier a direct part of the telescope mounting The pier was checked with a transit instrument at frequent intervals during the pouring operation, and though its top is 30' above the ground level, it has since been found to be within one millimeter of its correct position The bearings have an adjustment of ½". The pier, with 8" reinforced concrete walls, is hollow inside, and this provides a 'strong box' on the first floor of the observatory

"The polar axis is made of arc-welded steel plate instead of the usual castings

Figure 1 **The telescope drive in its box**

Two sectors were cut from a flat plate and rolled into cones These are internally braced with fins welded in at the points of greatest stress The larger ends of the cones are bolted to a cube of nickel-steel, through which the declination axis passes at right angles The unit is free from flexure and has five times the necessary strength Each end is fitted with an 8", Timken high-precision, tapered roller bearing The 2000-pound counterweight is rigidly attached to the polar axis The saddle, in which the optical tube rests, is a standard 18" channel braced with a number of small fins welded in to make it rigid The declination axis is a standard steel tube that permits the projection of the Cassegrain cone through it. The Cassegrain image may be observed only 2' from the center of rotation.

"Movement of the telescope is accomplished entirely by electric motors. These drive two large gears that contain some new ideas The right ascension gear has a bronze tire shrunk on an iron center It is 50" in diameter and has 400 worm teeth cut in the bronze The 48" declination gear is made from the same pattern, but has a ring of internal teeth bolted to its side. The outside of this gear is machined and marked with a setting circle Circles and gears are combined in the same piece The declination gear is driven

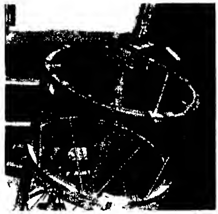

Figure 2 Upper end of the tube

by two 1/20 h p motors working in unison and driving four pinions mounted in the stationary counterweight

"The glass enclosed drive (Figure 1) which controls the telescope in right ascension is simple, quiet, and all in one compact unit Exposures of an hour at the 15' focus have been made, with no noticeable drift of the star from the cross hairs Worm gears are used throughout, to attain quietness A 1/12 h p synchronous motor, shown at the right in this figure, drives the 50" R A gear (part of which shows at the extreme top in the illustration) through a differential and four reductions—8 to 1, which is built in the synchronous motor, 16 to 1, 50½ to 1, and 400 to 1 at the large worm gear—to gain the sidereal rate The small motor (center) turns the differential box in either direction and at any required speed, but when the differential is stationary the telescope does not noticeably depart from the ideal clock rate The differential is used only when special rates are desirable, such as exposing star trail checking plates or guiding on some object that does not have the sidereal rate.

"The motor shown at the left in Figure 1 is a ¾ h p, high speed setting motor which is thrown in and out of engagement by an automatic electric clutch located in front of it The whole driving assembly was designed by C. D. Turner, V E. Maier and A F. Pittman Dual controls are mounted on the floor of the observatory and on the observing platform. The accuracy of the drive is attained through the use of multiple thread worms With these any desired ratio may be obtained. The second reduction in this train, for example, consists of a double-thread worm driving a gear with 101 teeth, providing a ratio of 50½ to 1.

Figure 3. Looking down the tube

The use of multiple thread worms seems to be a new idea—at least it was evolved independently in Indianapolis Through a suitable choice of ratios, the clock rate was lengthened 25 seconds per sidereal day to compensate for atmospheric refraction.

"The control panel, shown in the central illustration on page 347, has three knobs which control R A., Dec., and dome movements The variable speed, reversible, motors are controlled by rheostats driven by the control knobs These enable the operator to set the telescope at high speed or to give it just a touch over a small angle There are no manual locking devices, and the rheostats make it impossible to start the instrument with a jerk or to subject it to undue stresses

The optical tube (Figures 2 and 3) is made entirely of Lynite, Alclad, and Zeppelin Tube—all aluminum alloys The tube contains over 500 pieces, all drawn together by an ingenious arrangement of tension struts Flexure has been adjusted out of the tube by adjusting the tension at the proper points The chief advantage of the Lynite tube is its mobility and freedom from hulkiness Inertia and momentum are reduced to a minimum and the drive consequently can handle it much more smoothly Had it not been for the many weight-saving devices incorporated in the instrument, its moving weight would have been more than double its present value—5200 pounds All the accessory parts are made of aluminum or stainless steel, to eliminate troublesome rust which tends to occur in an unheated dome. The accessories, as well as the mounting, were all made by C D. Turner.

"Figure 2 also shows the upper end of the telescope, with the plateholder used at the prime focus. The upper section of the tube rotates on adjustable Torrington needle bearings shown in the same figure and the Newtonian plateholder can be turned to any convenient position. Guide stars are sent to the small telescope mounted on the rim of the tube. The double-slide plateholder makes guiding convenient and simple. This device is to have a coma-corrector installed, at the suggestion of Dr. Harlow Shapley, to flatten the field over the 4x5 plate. Figure 3 also shows a view down the tube. The curved sheet just above the aluminized mirror surface is a stainless steel cover which curves to the inside of the tube when it is raised, and straightens out again when it is lowered on the mirror cell. The cover has a chamois skin gasket. A tiny spot in the center

of the mirror is paint, applied to aid in collimation The prime-focus plateholder can be seen reflected from the mirror's surface

"Another piece of equipment that is different is the observation platform of the larger dome (Figure 4). Its design was evolved chiefly from Dr E F Carpenter's platform at Steward Observatory, Tucson, Arizona The chief difference lies in the

Figure 4 The observation platform

method of supporting the load This platform, which has a capacity of six persons, is supported by two long steel arches which span the inside of the dome on either side of the shutter opening They stand on the dome's steel base ring, and are also strong enough to contribute to the support of the dome's wooden superstructure The wooden platform floor is suspended from two straight tracks welded, like chords, to the arches at the correct incline The platform, with its rollers, is pulled up and down these tracks by steel cables and a ½ h p motor The hoisting mechanism is mounted in the upper part of the dome, back of the opening The dead weight of the platform is relieved from the hoisting mechanism by a counterweight on the opposite half of the steel arches The entire assembly is independent of the dome and would operate as well if it were standing by itself It allows access to any point reached by the upper end of the telescope There are no blind spots with this instrument The switches and wires at the right, in Figure 4, operate the dome, platform and telescope There are no wires on the telescope tube

"The second, or small, dome (Figure 5) houses a 5" Zeiss triplet apochromatic refractor that matches the performance of instruments many times its size This telescope has a full complement of accessories, including those for solar work The smaller dome is made in two halves, so that much of the sky may be seen at one time One half is just an inch smaller in radius than the other This dome is framed of steel channels rolled to radius and welded into place The inside of the dome is covered with Sprayoflake, a patent heat insulator, sprayed on with a hose This keeps the interior comfortable during hot summer days

"Except for the study room, which is well insulated and is heated electrically, the observatory building is not heated It has its own water system and fire protection The interior has hardwood floors, panelled knotty pine walls, and beamed ceilings A spiral staircase leads to the large dome and telescope, and a smaller stair to the other dome

"The administration of the observatory has been invested in a non-profit corporation called the Goethe and Helen Link Foundation for Scientific Research. Its purpose is to advance the science of astronomy in the state of Indiana. Dr. Link has endowed the observatory with a permanent income. Dr. James Cuffey, the first astronomer from Indiana University to hold the position of research fellow at the observatory, has already published work done with this instrument Dr B. C Getchell, astronomer at Butler University, Indianapolis, uses the observatory, as do many teachers in central Indiana Samuel Waters, who originally inspired its creation, is president of the Foundation The writer, an Indianapolis 'TN,' supervised and coordinated the work of construction, and is employed as director of the observatory

"The builders of the observatory are indebted to the many members of the astronomical profession who have aided in its successful completion

"All agree that the spirit of unity and co-operation created by Scientific American's two 'Amateur Telescope Making' volumes is chiefly responsible for the existence of the new Goethe Link Observatory. With regard to the mirror, about which another 2000 words might be written, a Hartmann test, reduced by Dr James Cuffey of Indiana University, disclosed a 'Hartmann criterion' of 066 second (Those who have memorized 'the book' will recall that this figure represents the least diameter of the cone of rays, approximately in seconds of arc, reflected from the mirror's surface) This mark is but 0 016 second from the record set on the McDonald mirror Greater accuracy is not necessary, as the inherent diffraction in the instrument enlarges the apex of the cone to twice this amount even with perfect atmospheric conditions The mirror was aluminized by Leroy M E Clausing

"The 8½" by 12" flat also was made by Charles Herman and V E Maier "

IN almost no time, after the publication of "ATMA," describing the Richest-Field Telescope which shows the maximum number of stars possible in one field, these

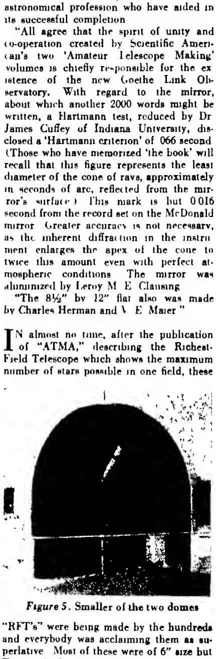

Figure 5. Smaller of the two domes

"RFT's" were being made by the hundreds and everybody was acclaiming them as superlative Most of these were of 6" size but Figure 6 shows a 12½" RFT, the one nearer the reader, made by J. F. Simpson, a medical and X ray technician at Garrison General Hospital, Gastonia, North Carolina, and set up on a roof. It is an $f/5$ and Simpson says it "shows most beautiful star fields, while the Orion nebula is more brilliant than I have ever seen it. When look-

ing at the Moon, it is actually necessary to hold your hat over the mouth of the tube to cut down the superabundant light."

The other telescope, mounted tandem in a long yoke of corner-welded angle iron filled in with two-by-fours, is a 12½" Cassegrainian. These two make just the right combination for non contortionists the Cassegrainian higher up and used from below, the Newtonian below and used from

Figure 6 Simpson's new equipment

above The tube of the RFT turns in the solid trunnion ring shown to place the eye piece wherever most convenient

Simpson formerly had the 12½" Cassegrainian and an 8" RFT mounted in tandem on the same roof (described in the March, 1940, number) but each in a fork instead of a yoke This lacked stability, but the double yoke affords great stability, he now testifies Simpson's intention is to link the two tubes together with a rod (detachable whenever desired) so that they will always cover the same field

OF side interest to "TN's" is a recent improvement in commercial silvering of ordinary looking glass mirrors, developed by Peacock Laboratories, Inc, 54th St and Paschall Ave, Phil, Pa, a Libby Owens Ford subsidiary Old method was to wash the glass, go over it with tin chloride, wash this off, lay the glass on a heated table and pour on, from a pitcher, the mixed ammonia-silver-nitrate-plus-reducing solution, using 8 oz. per sq ft, and wait 20 to 60 minutes for the coating New method employs a two-nozzle spray gun Emerging from it in a spray, the two solutions meet and mix 7" in front of the nozzle, and continue to the glass The glass is sloped and moves on a conveyor belt, greatly speeding up the work Claims are that 1 oz. silver nitrate silvers 30 sq ft of glass, showing how wasteful our telescope mirror methods must be — or were before aluminizing took the lead

NEW clubs of amateurs· The Amateur Astronomer's Club, S. Rasmussen, Cor. Sec., 720 Westover Ave., Norfolk, Va Telescope Makers of Central California, Jos. A. Mello, Sec., Suite 222, First Nat'l Bank Bldg., Madera, Calif.

CURRENT BULLETIN BRIEFS

(The Editor will appreciate it if you will mention Scientific American when writing for any of the publications listed below)

MARVELS OF THE ELECTRIC EYE is a 16-page illustrated pamphet which describes a number of uses for photo-electric-cell control systems. It covers such applications as conveyor control, automatic lighting, burglary protection, color sorting, and so on *United Cinephone Corporation, 43-37 33rd Street, Long Island City, New York, New York.—Gratis*

TWO DAYS—TWO WEEKS is a 96 page vacation guide to the United States, Canada, and Mexico It lists in compact form national parks and forests, state parks, major resort areas, ways to vacation, ways to travel, and tells how to obtain further information on specific subjects The listings are as comprehensive as possible and in most cases include a summary of costs *Harian Publications, 270 Lafayette Street, New York, New York —50 cents.*

AERO-THREAD ENGINEERING STANDARDS AND TECHNICAL INFORMATION is a 16-page booklet which describes and illustrates uses for a new screw system employing an anti-friction thread lining The information contained would be of interest to all manufacturers who use screw parts where maximum strength and reliability are desirable factors Request Bulletin T-1 *Aircraft Screw Products Company, Incorporated, 25-12 41st Avenue, Long Island City, New York —Gratis*

GEOLOGIC ANTIQUITY OF THE LINDENMAIER SITE IN COLORADO, by Kirk Bryan and Louis Ray, Harvard University anthropologists, is a 76-page general round-up of existing facts about this famous site of early Folsom man. *The Smithsonian Institution, Washington, D. C. — 35 cents.*

TELEVISION RELAYING is a reprint of an address by Dr W. R. G Baker in which is put forth a brief description of the General Electric Television Relay System. It outlines the reasons why relays are necessary for this work and tells something of the operations of a relay circuit in upstate New York *Radio and Television Division, General Electric Company, Bridgeport, Connecticut —Gratis*

HOW TO ORGANIZE A SCIENCE CLUB is a 36-page illustrated booklet that describes just how to go about the organization of a science club It also tells of some of the work that has been done throughout the country and presents illustrations of the activities of organized clubs *The American Institute of Science and Engineerings Clubs, 60 East 42nd Street, New York, New York. Gratis.*

TENITE MOLDING is a 40-page technical handbook on the methods employed in molding Tenite articles. Thoroughly illustrated, it contains a discussion of different types of molds, mold construction, molding temperatures, and molding pressures. Diagrams and detailed explanations of eight typical mold designs are included. This booklet is available to manufacturers, molders, and designers. Please request it on your business letterhead. *Tennessee Eastman Corporation, Kingsport, Tennessee.—Gratis.*

RECEIVING TUBES, pamphlet 1275-B, presents a chart of RCA receiving tube characteristics and socket connections The data on all RCA glass, glass octal, octalox, and metal types are presented in numerical-alphabetical order. *Commercial Engineering Section, RCA Manufacturing Company, Incorporated, Harrison, New Jersey —Gratis*

CHEMICALS BY GLYCO is the latest edition of a comprehensive 96-page catalog describing glycol and glyceryl esters, emulsifying agents, special emulsions, synthetic waxes, synthetic resins, and a number of specialties of wide interest and application A section is devoted to suggested formulas and other information for the manufacturer of numerous types of products *Glyco Products Company, Incorporated, 148 Lafayette Street, New York, New York.— Gratis.*

HERCULES DIESEL ENGINES is a 16-page illustrated pamphlet which gives a concise yet comprehensive explanation of modern high speed, heavy-duty Diesels Handled in question and answer form, some interesting comparisons are presented between Diesels and gasoline engines as well as between the two-cycle and four-cycle Diesels *Hercules Motors Corporation, Canton, Ohio —Gratis*

AGFA PHOTOGRAPHIC PAPERS, Their Properties, Processing and Applications, is a 48-page booklet which includes clear and detailed description of the various factors and conditions that govern the use of photographic papers *Agfa Ansco, Binghamton, New York, or photographic dealers.—15 cents*

ALUMINUM IN THE CHEMICAL INDUSTRY is a 52-page booklet divided into five parts. Choosing the Proper Alloy, Applications of Aluminum in the Process Industries; Coatings, Protection, and Maintenance of Aluminum; Chemicals and Alcoa Aluminum; Characteristics of Aluminum Complete with a comprehensive index. *Aluminum Company of America, Pittsburgh, Pennsylvania.—Gratis.*

AMPRO PRECISION CINE EQUIPMENT is a catalog which describes and illustrates a complete line of silent and sound 8 and 16mm motion picture projectors It is available to dealers in such equipment, as well as educational and industrial prospects. *The Ampro Corporation, 2839-51 North Western Avenue, Chicago, Illinois.—Gratis.*

ACTIVITIES IN THE FIELD OF VIRUS RESEARCH, by Paul de Kruif, is a report of the work being done by the National Foundation of Infantile Paralysis. It outlines the progress which has been made up to the present day and describes the long-range research effort which is continually being carried on. *The National Foundation for Infantile Paralysis, Incorporated, 120 Broadway, New York, New York.—Gratis.*

LEGAL HIGH-LIGHTS

Patent, Trade Mark, and Related Legal Proceedings That May Have a Direct Effect on Your Business

By ORSON D. MUNN, Litt.B., L.L.B., Sc.D.

New York Bar
Editor, Scientific American

ETHYL

THE recent decision of the United States Supreme Court with regard to the licenses for making, using, and selling gasoline containing a patented fluid bearing tetraethyl lead has given rise to considerable newspaper comment Much of the newspaper publicity implies that the decision is revolutionary in scope and has introduced new principles into our patent laws Actually the decision is orthodox and is based upon well-established principles. Underlying the decision is the fundamental principle that after a patented article is sold in commerce by the patentee or his licensee the patentee can no longer exercise any control over the article

In the decision under consideration the Supreme Court found that the patentee was the owner of patents relating to a gasoline additive containing tetraethyl lead and also to gasoline incorporating the additive The patentee granted licenses to most of the large oil refining companies in the United States to manufacture, sell, and distribute motor fuel containing the patented fluid The licenses prohibited the refiners from selling the patented fuel to anyone except retail dealers and jobbers licensed by the patentee In addition, the license to the refiners provided that the refiners should maintain certain price differentials in the gasoline embodying the patented fluids

The patentee also granted royalty-free licenses to jobbers to sell gasoline manufactured by the licensed refiners and it was the system of licensing jobbers which the Court found to be in violation of the anti-trust laws The jobbers licenses provided that either party could cancel the license, with or without cause, on giving 30 days notice in writing.

The Court found that it was an established practice of the patentee to investigate the business ethics of licensed jobbers in order to ascertain whether they maintained the marketing prices, policies, and practices prevailing or ostensibly prevailing in the industry. As a result of its practice of investigating business ethics, coupled with its power to cancel the licenses at will, the Court found that large numbers of refiners and the majority of jobbers believed that it was necessary for the jobbers to maintain the required business ethics and to maintain prices in order to obtain and retain their licenses From this it was concluded by the Court that the patentee was exercising control over the resale price of the jobbers for gasoline containing the patented fluid.

The Court pointed out that a patentee "may grant licenses to make, use or vend, restrict in point of space or time, or with any other restriction upon the exercise of the granted privilege, save only that by attaching a condition to his license he may not enlarge his monopoly and thus acquire some other which the statute and the patent together did not give" The Court held that the exercise of the resale price of the jobber was beyond the scope of the patent monopoly because the gasoline had already been sold in commerce by the licensed refiner To correct this situation the patentee was enjoined from enforcing the requirement that licensed refiners should sell gasoline containing the patented fluid only to licensed jobbers. The patentee also was ordered to notify the jobbers that the jobbers' licenses had been cancelled

In reaching its conclusion the Court pointed out that the patentee had established "the marketing of the patented fuel in vast amounts on a nationwide scale through the 11,000 jobbers and at the same time, by the leverage of its licensing contracts resting on the fulcrum of its patents, it has built up a combination capable of use, and actually used, as a means of controlling jobbers' prices and suppressing competition among them"

STYLE PIRACY

DESIGNERS and creators of original fashions in clothing have made repeated but unsuccessful attempts to protect original fashions which are new but do not rise to the dignity of invention and accordingly cannot be protected by patent from style piracy The design and construction of garments, when they are new and embody invention, may be protected by patent However, very frequently new designs and fashions in clothing having great commercial merit cannot be protected by patent and within a very short time after the designs are displayed on the market many copies, usually of a less expensive character, appear on the market.

In an attempt to protect designers and creators from copying of this character a trade association of hat manufacturers and designers was organized The trade association established a registration bureau with which any creator of original designs and styles in hats could register his designs In addition to this more than one thousand retail stores in the United States agreed to co-operate with the trade association by refusing to purchase any hats which were copies or piracies of designs registered with the association. Members of the association in turn agreed among themselves not to sell hats to any retailer who persisted in purchasing hats that were copies of the registered designs

The Federal Trade Commission contended that the concerted action by the hat manufacturers belonging to the trade association was a violation of the anti-trust laws and ordered the association to stop further boycotts of retailers and manufacturers who had copied registered designs. The association appealed to the Federal Court and the order of the Commission was sustained The Court conceded that design or style piracy was an evil that had adverse effects upon the creators of designs However, the Court pointed out that under our law only designs embodying invention were subject to patent protection and that any other design could be copied at will by competitors Since this was the policy of our law, the concerted action of the manufacturers belonging to the trade association was held to be a violation of the anti-trust laws

In this connection the court made the following statement

"We believe, therefore, that concerted action to eliminate style piracy extends beyond the permissible area of industrial self-regulation The purpose of the milliners is to maintain their price structure, and to eliminate a distasteful 'evil' which the law nevertheless recognizes to be a socially desirable form of competition."

DIAZO-TYPES

PATENTS relating to chemical compositions and processes present a peculiar difficulty not encountered in connection with patents for other types of subject matter Thus where an inventor employs, in a chemical composition or process, a specific element such as chlorine, he naturally does not wish to be limited in his patent to that particular ingredient. In an attempt to make his patent as broad as possible he might state that the entire halogen group of materials may be employed If it should later appear that one or more of the halogen materials are inoperative in the process or composition then all of the claims of the patent specifying the use of halogens are invalid and only those claims limited specifically to chlorine are valid

An example of this principle is contained in a recent case decided by a Federal Circuit Court of Appeals relating to a patent for photo sensitive copy papers known as diazo-types, used in reproducing engineering drawings The patent stated that the paper should be coated with two materials, one of which was stated to be "a diazo compound being formed with amino compounds containing at least one other amino group" The patent contained both product and process claims, each of which specify the use of the above material. At the trial of the case it was proved that not all diazo compounds of this character would operate but only those containing a quinonoid or anhydride structure As a result of this evidence the Court concluded that the claims were too broad and covered materials which would not operate and accordingly were invalid The principle of law involved was stated by the court in the following manner

"Where within a general classification disclosed by the claims, are compounds which do not answer the description of the specification, even though there be a general quality common to them all, yet if there be no common quality in respect to their effectiveness in achieving the inventive concept, claims for their exclusive use cannot be sustained."

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SCIENTIFIC AMERICAN

ANNOUNCEMENT

Scientific American, a ninety-six year old international institution, will come to our readers in new form starting with the next—the August 1940—issue of the magazine.

Modern typography, a new cover design, a refreshingly different manner of presenting editorial material, will characterize the new Scientific American. Always in step with the trend of the times, the editors will give to our readers more news of the world of science and industry in more readable and compact form.

Yet, despite the increased tempo, there will never be any compromise with authenticity and accuracy. Old readers of Scientific American will appreciate what this means; new readers will quickly grasp the advantages of this editorial policy that has been maintained for almost a century.

Orson D. Munn

Editor

The SCIENTIFIC AMERICAN DIGEST

SCIENTIFIC AMERICAN

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NINETY-SIXTH YEAR • ORSON D. MUNN, Editor

CONTENTS • JULY 1940

IN the article starting on page 5 of this issue is given a compact survey of the world's finest warplanes—those employed by the Air Services of the United States. On our cover is illustrated the North American observation plane, O-47A Note the windows in the lower part of the fuselage and the full-vision cockpit enclosure The eyes of the Army must see all - *Official Photograph, U S Army Air Corps*

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50 Years Ago in . . .

Scientific American

(Condensed From Issues of July 1890)

CANAL—"It is now over eight years since work was first begun upon the Panama Canal, and about two years have elapsed since active operations were suspended The total cost of the work up to the present time, including the indebtedness of the company, is estimated at seven hundred millions of dollars, and the canal is hardly half finished"

CRUISER—"The squadron of evolution sent by the United States government to the Mediterranean, under command of Rear-Admiral John G Walker, attracted much attention The admiral's flagship was the frigate-built cruiser *Chicago* constructed of mild steel, at a cost of about one million dollars, and launched in 1885 She is 334 ft long, 48 ft broad and draws 19 ft, having a displacement of 4,500 tons She has two screw-propellers, with engines of 5,500 horse power, indicated, the machinery is protected by a partial steel deck Her speed is 15 knots an hour, and she carries 940 tons of coal The armament consists of four 8 in breech-loading guns on the spar deck, eight 6 in breech loading guns, in broadside, on the gun deck and two 5 in breech loading guns aft, with six machine guns"

GUNPOWDER—"No evidence exists of the use of gunpowder as an agent of warfare until the middle of the twelfth century, nor did a knowledge of its propulsive effects come to the Chinese until the reign of Yunglop in the fifteenth century a thousand years after its first employment in fire crackers"

GLASS—"A new method of obtaining stained glass is done by a process of printing The design is embossed on an iron plate, on which a lump of hot glass is rolled until it takes the form of the plate on which the pattern is cast The sunken lines are then filled with enamel and the whole plate is fired This process obviously does away with the use of leads, is rapid in its execution, and has the additional advantage that the design may be repeated as often as it may be required"

TOOTHPICKS "Quill toothpicks come from France The largest factory in the world is near Paris, where there is an annual product of 20,000,000 quills The factory was started to make quill pens, but when these went out of general use, it was converted into a toothpick mill"

GIRDER—"The Keystone Bridge Co has just completed a girder for the new City Hall of San Francisco, which is the largest ever made in the United States It is 105 feet long, and weighs 70 tons A contract for two girders was given to the company last November, and they have been working on it ever since The materials for the second one are now being prepared The girders are intended for the ground floor of the building"

WELDING—"The great demand for artificial ice machines, and the necessity for furnishing long coils of pipe to be used in their construction, has furnished a new and extensive field for the pipe welding machines of the Thomson Electric Welding Company The difficulty of welding pipe by the old methods is that, unless the joints are perfect, there is an escape of ammonia vapor which renders them practically useless It is found that by the electric welding process these joints are perfect, and lengths of 400 or 500 feet of homogeneous pipe can be made without difficulty The electric welds stand bending either hot or cold"

FOOD "Probably no modern science presents a wider field for speculation than that of chemistry, and more especially, perhaps, that branch of the science which treats of organic compounds In an address delivered at Heidelberg, by no less eminent an authority than Victor Meyer, it is announced that 'we may reasonably hope that chemistry will teach us to make the fiber of wood a source of human food What an enormous stock of food, then, will be found if this becomes possible, in the wood of our forests, or even in grass or straw'"

PAY TELEPHONE "A novel telephone station is being introduced in Connecticut The instrument cannot be used unless a fee is paid There are five slots in the machine for the reception of a nickel, ten cent piece, quarter, half dollar, and dollar respectively To use the telephone it is first necessary to call up the central, as on an ordinary telephone The objective point is then asked for, and when this is reached, the party who rings up is told to put the necessary fee in the slots"

SPEED—"A special train on the 15th July left Baltimore at noon, and thirty-five minutes later had traveled forty-two miles and was in the Pennsylvania railroad station in Washington The speed averaged 72 miles an hour, or allowing for starting and stopping, at least 80 miles for the greater part of the run"

AND NOW FOR THE FUTURE

¶ **Progress in the young and vigorous organic chemical industry By Dr C M. A. Stein**

¶ **Geriatrics—the newest medical specialty By Barclay Moon Newman.**

¶ **Pattee's Caves, where medieval Irish monks may have lived in New England. By Prof Hugh O'Neill Mencken.**

¶ **Evolution in the future: Will the human species ultimately produce a race of super-men? By Henry M. Lewis, Jr**

¶ **Brilliant achievement in the improvement of commonplace textiles. By Philip H. Smith.**

Personalities in Industry

DONALD W. DOUGLAS

BORN in Brooklyn, New York, in 1892, Donald W Douglas was 11 years old when the Wright Brothers made their first flight at Kitty Hawk. Six years later he received his appointment as a midshipman in the United States Navy and was ordered to report to Annapolis In 1909 the two American inventors of the flying machine brought their frail biplane to Fort Meyer, Virginia, for a demonstration to the United States Army Young Douglas was among the few who saw the airplane leave the ground, fly around the course and return to its starting point He did not know it then but that event also marked the beginning of his career

After three years of training cruises, navigation, and mathematics, young Douglas still had his mind on wings and skies instead of the seven seas, and was ready to turn to new, untried fields. His father, William E Douglas, a New York banker, hoped Don would become a naval officer, but fate and Donald decreed otherwise In 1912 he entered the Massachusetts Institute of Technology His progress at the Institute was rapid He was graduated in 1914 and in June of the same year received an appointment at that institution as Assistant in Aeronautical Engineering at a salary of $500 a year It was his first job in aviation

With Commander J C Hunsaker, young Douglas worked on the first wind tunnel, a step that laid the foundation for the amazing development of aviation in the last quarter of a century In 1915 he joined the Connecticut Aircraft Company in New Haven as a consultant and there worked on the D-1, the first dirigible built for the United States Navy Later in 1915 Douglas went to Glenn L Martin and became his Chief Engineer Within a year he was Chief Designer for the Aviation Section of the Signal Corps, but later returned to Martin. At 25 he was one of the outstanding men in the fascinating new field of aeronautics

By 1920 Donald Douglas was working for himself He came to southern California and with David R. Davis formed the Davis-Douglas Co Their first office was "desk space" in a barber shop. There was designed the Douglas *Cloudster*, the miracle of its day It was only a step from the *Cloudster* to a Navy contract for several airplanes

In four years Douglas was ready for another milestone in his career. A new model, the *DWC* was finished and the United States Army was on its way to make its historic flight around the world by air The Douglas slogan became "First Around the World," and today is "First Around the World—Now the World Over"

At the age of 32 Donald W Douglas was internationally famous His organization grew until today the two Douglas factories at Santa Monica and El Segundo, California, are America's largest airplane plants. On May 1 1940, Douglas employed over 17,000 men and women, with a payroll of approximately $28,000,000 00

In 1932 Douglas entered a new field The historic *DC 1* and the *DC 2* changed aerial transportation in America. Soon Douglas airliners were dominating the skies. The 425th ship of the "DC" series was delivered in May 1940 Douglas airliners fly more than 350,000 miles every 24 hours in the United States and 22 foreign countries. To the safety record of 1939, when the airlines in the United States carried 2,000,000 passengers 815,000,000 miles without an accident, Douglas contributed equipment for 85 percent of this imposing record

Universal acclaim and recognition made no change in Don Douglas. In 1936 when President Roosevelt presented him the Collier Award for outstanding advance in aviation his associates still called him "Doug," as they did after he received, in January, 1940, the Guggenheim Gold Medal for the outstanding contribution to the development of commercial and military airplanes

He is married and lives with his wife and children in Santa Monica, close to the huge Douglas plant Reading, yachting, and quiet hours with a few close friends are his recreation Never flustered, seldom disturbed, always calm and collected, he continues to keep pace with the amazing progress of the thing closest to his heart—aviation

THE WORLD'S MOST POWERFUL X-RAY APPARATUS

THREE principal objects in this group are, at right, a 1,400 000-volt X ray tube, in center, a high voltage generator to feed it, at left, resistance units General Electric has built this big apparatus for the National Bureau of Standards, which will use it, first, to explore X ray dosage at the higher voltages into which medicine is pushing, later for producing neutrons and artificial radioactivity for physical research The 1,400,000 volt, 10 milliampere X-ray tube is composed of ten sections of 140,000 volts each in cascade, each section is fed individually by its corresponding section of the ten part generator This is composed of step-up transformers, capacitators, and kenotron rectifier tubes Resistance units in left hand stack are used in measuring the voltage X-ray tube is 28½ feet high, and its beam of electrons travels 24 feet In operation these electrons start at zero velocity and are given a velocity kick in each section, so that at the target the speed is 180,000 miles per second—very nearly the velocity of light. Curved tops of each stack are spun aluminum corona shields to prevent loss of electricity to the atmosphere

Official photograph, U S Army Air Corps

A Boeing flying fortress, world's largest service ship, which will be dwarfed by a 72-ton ship now building

AMERICA'S WINGED WEAPONS

World's Finest Warplanes . . . Built to High Standards and of Superior Material . . . What the Various Types are Designed to Accomplish

By **JAMES L. H. PECK**
Author of "Armies With Wings"

AN embittered Spain, a disunited Poland, and a capitulated Finland bear mute testimony to potency of modern airpower, what remains of the Old World appears destined to suffer at the hands of this new weapon—swiftest, most far-reaching of Man's war agencies. And all of this has a very definite effect upon American defense in general and our air arm in particular

The sleek warplanes, which are literally the sinews of this American air arm, are much in the news these days, current discussion is international as well as national These fighting craft are of several types, each of which is designed for one of the tactical sub-divisions of our Army Air Corps or Naval Air Service The tactical branches of the former include pursuit, attack, observation, and bombardment Naval branches are somewhat similar, and comprise fighter, scout-observation, patrol, and bombing squadrons The small but colorful Marine Corps flying organization is an integral part of the Navy Bureau of Aeronautics, and their equipment is of essentially the same pattern

Fighters and pursuit-interceptors are the smallest of combat craft, their tactical function entailing the destruction of enemy bombers and combat ships The designation "interceptor" has been applied to American planes only recently, although England has, for many years, employed single- and multi-seater planes of this type Its primary use is to fly up and out to intercept approaching hostile planes The interceptor is usually designed for extremely fast climbing and is heavily armed Fighters and pursuits are usually more maneuverable, and engage in close and rapid in-fighting while the interceptors indulge in hit-and-run tactics The new Air Corps pursuit-interceptors are single-seaters, having four machine guns and aerial cannon mounted stationary within the wings or the cowl in front of the pilot's cockpit The ships are aimed and flown at the target, while the guns are fired automatically by hydraulic or electric devices, the triggers being mounted handily on the ship's control sticks.

The much-publicized Bell P-39 "Airacobra" and Vultee "Vanguard" are typical prototypes. The Bell YFM-1 'Airacuda' and Lockheed P-38 are twin-engined craft of somewhat larger dimensions, the former being our only multi seater (five-man) fighter. The newest models are the Curtiss P-42 and P-46 and the Navy's Brewster F2A-2 All of these sparkling craft are superior to any in the world in their respective classes - which is why the Anglo French Purchasing Commissions are not exactly unhappy

COMBAT planes are evaluated in terms of their performance—how fast they fly at both cruising (with 60 to 75 percent full power) and top speeds, how easily and rapidly they may be maneuvered through the aerobatics occasioned by combat, and how quickly they can take off and climb to high altitudes to meet the enemy In addition, they must have a high "factor of safety" and good flying characteristics in general, with safe landing and take-off abilities in particular

This behavior, however is but a means to an end High speed is essential mainly for the purpose of overtaking or escaping enemy craft, a rapid rate of climb, to get the defending planes up to the altitude of the approaching ones; and maneuverability, for the sole purpose of outflying hostile ships so that the guns—"firepower"—may be brought to bear No warplane is any more effective than its armament, and the successful employment of this, in turn, depends upon the man behind the gun

None of the World War II warplanes

rank so high on *all counts* as do our new pursuit-interceptors, two of which are some 70 miles faster than any Nazi ship known to be in service, and four of which will climb to 10,000 feet in far less time than Britain's "Spitfire," topmost World War II climber

Planes of the attack branch are designed for assaults on ground troops and matériel in a low-flying operation called "strafing," employing machine-gun fire, small and medium-sized bombs (30 to 100 pounds), and contaminating chemicals After using attack planes which were slightly larger than pursuits for several years, the Air Corps has found the 60-foot, twin-engined attack bomber more satisfactory These "winged tanks" carry more fuel and bombs than the smaller attack plane, and this added gas capacity permits them to accompany larger bombers on a mission far beyond the cruising range of the former type The two motors make for increased speeds and also provide better forward visibility for the pilot This is paramount when flying 400 miles per hour at tree-top altitude! The new Douglas A-20A almost attains this pursuit plane speed with a full warload of bombs, fuel, and war chemicals Although this ship, the Martin 167W and North American NA 40A, carry crews of from three to five men, the forward-firing guns, which are mounted in the wings, are fired by the pilot in the same manner as those on a pursuit plane A rear gunner holds forth in his enclosed turret to ward off would-be back-biters, and the bombardier bombs from his vantage point in the ship's nose.

Encamped troops, or those who are marching, are easy prey of attack bombers, and these ships support friendly infantry advances by strafing enemy trenches, artillery, and machine gun emplacements A most important mission, however, is the support of bombing operations, wherein it becomes the strategy of the attack planes to "neutralize" or destroy the anti-aircraft batteries which protect the objectives sought out by their big brothers, the medium and heavy bombers The low flying onslaught enables the attack bombers to flash from behind terrain features and trees upon the unsuspecting victims with the element of surprise and blinding speed in their favor. Anti-aircraft gunners who are being harassed by parachute bombs and mustard spray are practically helpless for all their marvelous fire-control gear, all of which makes the attack bomber the most deadly thing on wings

THE air raider's tactical function is to bomb to destruction such enemy objectives as air bases power stations, reservoirs and pumping stations, shipping and docks, mills, factories, and other sources of material and food supply, communications and transportation centers, troops and fortifications—most of which are to be found within city limits and necessarily involve the military and the helpless alike

Heavy bombers, such as our Boeing flying fortresses, are designed to carry huge fuel and bomb loads for long distances. A six- or eight-man "combat crew" comprises pilot, co-pilot, bombardier, radioman, navigator, and gunners, most of whom are quite versatile in that they can exchange places and jobs when necessary These types are four-engined monoplanes having machine guns disposed about the huge ship in such a manner as to provide defensive fire from all angles The Air Corp's Douglas B-19, now building, weighs 72 tons and has a cruising range that will permit a round trip flight between New York and Paris

However, not all bombardment missions call for long-distance flying, and because of the poor strategy involved in employing the long range bomber for not so-long operations, the fortress' little brother, the medium bomber, came into being. This is a twin-engined monoplane which is smaller and faster, and carries less warload over shorter distances

Because of the diversification of Navy bombers a word is timely regarding the "egg layers" of the flying fleet In lieu of the heavy bomber, the Navy employs a 13-ton patrol bomber of the now famous Consolidated PBY type which gained popularity through the record-breaking formation flights to Hawaii and the Canal Zone sometime ago These are twin-motored monoplane flying boats The boats of Patrol Wing Five are conducting the Neutrality Patrol

Official photograph, U S Army Air Corps
Rated as the world's fastest pursuit-interceptor, this Lockheed P-38 has two 1150-horsepower engines

Official photograph U S Army Air Corps
Note the wing guns in this Martin 167 attack-bomber Top speed is 355 miles per hour

off the Atlantic coast These are the aerial cruisers of the fleet, and with their formidable range the PBY boats can fly hundreds of miles to spy out enemy ships

The torpedo bomber is a single en gined, low wing monoplane of about 50-foot wing span These craft carry a 2000-pound torpedo and are carrier based landplanes In action, they skim just above the waves, headed straight for their floating target release the "fish," then pull up and away before the explosion occurs

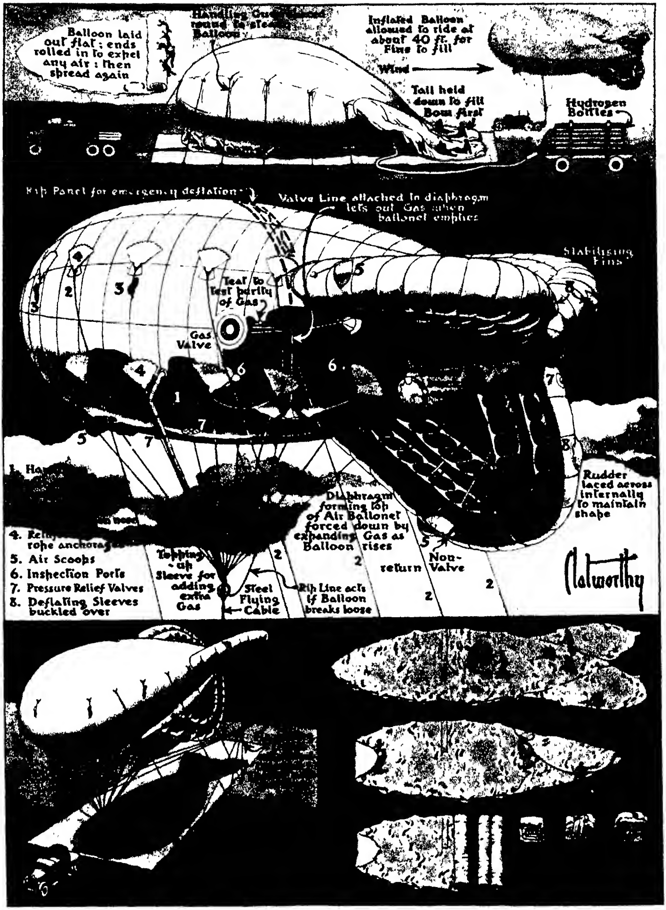
The scout-bombers and dive bombers are smaller—the Curtiss SBC-4 "Hell diver" having a 34-foot span—and faster. The scout bombers carry on short-distance reconnaissance, and when necessary they stop scouting and com mence bombing Both these prototypes employ the spectacular vertical dive attack, in which they scream down at around 400 miles per hour, aimed at the target, release their bombs, then pull up when about 500 feet above the sea

Bombing teams—pilot and bom bardier—of the patrol bombers and the Air Corps types lay their death eggs in a less spectacular method from higher altitudes. When the bombs are released from the racks in which they are suspended in the plane's belly, they do not fall straight downward, but travel forward with the ship for a distance before heading earthward in a parabolic trajectory. This behavior—that is, the forward movement from point of release—is called "range" and it varies with the plane's speed and altitude From 6000 feet, a bomb would have a range of about a mile and a quarter if the bomber is flying 240 miles per hour, at the same speed, the missile would have twice this range—or 13 648 feet—if dropped from 12,000 feet But range is only one of many considerations, and all these are neatly taken care of by the bomb sight The bombardier makes settings to correspond to the plane's speed, altitude, wind drift, ground speed, and other technicalities, and sights down and ahead until the target is lined in the telescopic view finder, then merely presses a button Electrical apparatus and science take care of everything The miraculous accuracy of our Sperry sight is pretty well known by this time both in and out of the United States!

OBSERVATION work is not so glamorous as that of the combat branches, but it is equally important Aerial reconnaissance—the "eyes of the Intelligence"—is perhaps the most important original source of enemy information available to ground commanders Flights over the hostile back areas, trenches, and cities, and the photos thereof, supply invaluable information of enemy movements The North American O-47A, an all-metal, mid-wing monoplane, which is provided with a windowed belly for the observer and his all-important camera, is the current Air Corps observation plane.

Another unglorified branch which is employed by both the Army and Navy forces bears the simple title "Utility," but it is most essential to the smooth operations of the air forces Cargo ships fly all sorts of equipment to air bases or outlying posts Transports—which are largely of the Douglas DC-2 type seen at most airline terminals—are necessary for the rapid movement of personnel and staff officers Ambulance craft have saved many a life by swift, comfortable transportation of injured personnel to a place where medical at tention was available The military version of the Douglas transports employed for these purposes is known as the C-39. Last, but far from least, come the vitally important training craft of "primary" and "basic" designations, two of the newer types being the Army's Vultee "Valiant" and the Navy's North American SNJ-2 Fledglings must undergo gradual, carefully supervised transition from these trainers to the speedy, tricky pursuits or giant bombers

These are the world's finest warplanes, they fly faster and farther than any of the respective foreign types known to be in service or building, and they are built to higher specification standards and of superior material. Our services, unlike most of those across the water, believe as a matter of policy that American airmen are worthy of the finest airplanes that engineering ingenuity and money can provide—and we have more of both than any country in the world.



CREW OF TEN HANDLES A LONDON BARRAGE BALLOON

EFFICIENCY of the London balloon barrage has been proved by the unfortunate wrecking of two friendly airplanes since the war began Such barrages have shown their effectiveness to discourage mine-laying by airplanes in estuaries Each balloon requires a winch-truck and a trailer; and is made ready for flying by ten soldiers and a corporal.

OUR POINT OF VIEW

Who Ever Dares Say Never?

IT isn't safe any longer to assert that anything will "never" become possible. Since a long time ago every scientist has known that you never could expect to see clearly objects much smaller than about 1/100,000 inch in diameter, no matter how expensive a microscope you might devise. The watertight reason for this was the obvious one that a hundred thousandth of an inch was not far from the size of pattern of the very thing by means of which you did the seeing, that is, light. Things smaller were not properly noticed by the light to afford a clear image and there was nothing you could do about it. So we had reached the ultimate limit of working magnification at little more than 2000 diameters.

This permitted you, however, to see most of the disease germs. You could see them about as clearly as you can see and recognize a man standing off at some distance, with the naked eye, that is, you could see their general outline but not much of their detail. By wholly different methods than seeing, science could, of course, deduce and prove the existence of many things smaller, smaller, smaller, smaller, smallest, by several degrees of size, than germs, that is, disease viruses, large organic molecules, common inorganic molecules, atoms, parts of atoms. These proofs established the existence of such sub entities just as fully as if you could see them—perhaps more so, since seeing isn't always believing. Yet you always felt that you wanted an actual look at these things and you were told that you would never get that look.

Today, thanks to the electron microscope so lucidly explained on another page by the young physicist, Jean Harrington, we expect soon to behold clearly, not, it is true, parts of atoms or even whole atoms, but the entities that stood next higher on the forever forbidden list, that is, viruses and large molecules—the latter have been seen already. The electron microscope at one jump has multiplied our power to peer into the vastness of the minute just about fifty times, it permits a magnification of 100 000 diameters! It would even permit us to see atoms if certain wide practical discrepancies between its theoretical and actual power did not still bar the way. Won't these "bugs" be disposed of? Some may. Yet the men who have wrestled with the problem in the flesh think the electron microscope never can come within five percent of its full theoretical resolving power. Some practical reasons are human inability to attain perfect symmetry of parts, to a degree way past even fine machine work, tiny residual irregularities in coil windings, residual ripples in voltage control that cause variations in electron speed, though you control it, as RCA has, within three volts in 70,000, and, finally, the very same hard-boiled family of aberrations—chromatic, spherical and the others—that have always bedeviled glass lens design.

This super microscope, which is now coming into its fruition stage after about a decade of difficult development, is the result of a combination of strategem with a great deal of invention, experiment, tenacity, and refinement of technique. Confronted by a blank wall science made a flank movement. Since images of things far too small to fit the pattern of ordinary light were needed, resort was had to a kind of light having far finer texture—electron waves. Electron waves being invisible to our eyes, they were then transformed, by means of the substances on the fluorescent screen, into waves which our eyes could perceive. These substances can take in the electron energy, change it into light, and send it out again—visibly. And there, on that screen—for example, in the electron microscope at the Camden laboratories of the RCA—you can look into a glass-covered window and, with entire comfort—no squinting—see large greenish images of things magnified as man never before hoped to see them. It makes you feel a bit creepy. Here is a chain of streptococci linked together by a narrow waist, like the waists between linked sausages. It is molecular in size. Or a typhoid germ with flagella, like little whips, extending from it.

There are three important things in the biological world which for a long time have greatly annoyed scientists by being just too small to descry clearly in microscopes—the virus, the gene and the bacteriophage. Viruses—known cause of measles, influenza, smallpox, infantile paralysis, yellow fever, and the common cold—have for some years been suspected of being either half alive living things or half alive chemicals. Will the electron microscope lead us to a better understanding of viruses and thus to a cure of the virus-caused diseases? Second, the gene, that hereditary factor in our cells which determines our physical and other characteristics. Will the new tool enable us to discover new facts that may ultimately make for better animals and plants—even human beings? Third the bacteriophage, a sort of predatory germ—the germ's own germ—which kills bacteria. Medicine would greatly like to know just what this perplexing entity really is. Some scientists think it is as much smaller than a germ as a germ is smaller than an amoeba.

Finally, the electron microscope promises much of wealth-controlling value for industry. Probably there is no industry, using any kind of material that will not ultimately profit by the deeper insight into the real nature of the materials it uses which the electron microscope is expected to provide. Examples are the rubber industry (rubber's complex molecules), the cement industry, the paint industry, and the colloidal metals' industry. Laboratory workers equipped with this new instrument can not merely count the number of particles of a given material, as has long been possible by ordinary optical microscopes and ultra microscopes (which do not, however, resolve them into clear images) but now can actually see their all important size, shape, and especially their uniformity or variety. Industry already is awake to this new implement. Some companies—the Eastman Kodak Company, for example—are already using electron microscopes of their own design.

It cannot be said yet, and it may never be true, that the electron microscope will be accessible easily to every man who would like to have one around home just to amuse himself. The instrument now placed on the market by RCA costs, with its 100 kv regulated voltage supply, $17 500. It weighs 700 pounds and stands ceiling high, it is no portable vest pocket apparatus. Nor could the average man use one without special training, for it would be about as difficult for him to steer as a temperamental wife. The thing examined must first be placed on a film of nitro cellulose only 1/3,000,000 inch thick—literally next to nothing! Air must be evacuated from the whole interior, because the big atoms and molecules in it otherwise would obstruct the flying electrons and alter their necessary precision of path, just as a dense thicket of trees would obstruct a snowball fight. There is a delicate technique to be mastered before use.

This question of vacuum bears pointedly on a question we have several times heard suggested. "Why not make an electron telescope working on analogous principles?" To accomplish this it would be necessary to create and maintain a vacuum—a sort of "tunnel full of vacuum"—clear down through the earth's atmosphere to the instrument, and this would be such a tall order that the electron telescope will nev —*A G I*

THE CHEMICAL GIANT

Corrosive Sulfuric Acid . . . Indispensable in Peace and War . . . Used in Most Industries . . . Annual Production Runs into Millions of Tons

By WILLIAM H. WAGGAMAN
Chemical Engineer

THE present European conflict which threatens to engulf the world has been defined as a war of metal, petroleum, and high explosives But war also demands one other product about which the average person knows very little He is still less familiar with the part which it plays in manufacturing those weapons so essential in conducting modern warfare Yet, without this product, we would be unable to turn out the huge tonnages of fabricated steel, prevented from producing the millions of barrels of refined oil and gasoline, and powerless to manufacture the immense quantities of high explosives demanded by war

This product is sulfuric acid, a colorless, odorless, heavy liquid, the most useful of all manufactured chemicals—and also the cheapest It is produced in such enormous quantities that, even under normal conditions, the annual output is measured in millions of tons and, under war conditions, its production must be stepped up sharply to meet the increased demand

TABLE I
Sulfuric Acid Consumption in the United States by Industries, 1938

	Short Tons
Fertilizer	2,100,000
Petroleum	1,120,000
Iron, Steel, & Metals	850,000
Chemical	790,000
Coal Products	585,000
Paints and Pigments	430,000
Rayon and Film	310,000
Explosives	185,000
Textile	90,000
Miscellaneous	300,000
TOTAL	6,760,000

The only sulfuric acid which most of us have seen is that contained in the battery of our automobile We know this acid vaguely as a highly corrosive chemical which forms bluish green incrustations on the main cables leading from this storage battery, and that it will burn our hands and eat holes in our clothes if we happen to get splashed "Oil of vitriol," as concentrated sulfuric acid is commonly called, conjures up visions of a destructive product—and it is just that The main reason why we are so unfamiliar with this acid is that it seldoms appears in the final product which it is instrumental in manufacturing.

As is the case with almost every essential product entering into our complicated system of civilization, the United States leads the world in production of sulfuric acid Within a period of 27 years—1889 to 1916—our annual output of this chemical increased over 700 percent According to the latest figures of the U S Bureau of Mines, we produced, in 1938, 6,760,000 short tons, having a value of approximately $67,600,000 This acid was distributed to the various industries as shown in Table 1

The most recent figures available showing how the various nations compare in respect to their output of this acid are those of 1937, when their proportion of the world's total production was as itemized in Table 2

WAR and preparation for war are reflected in the figures for Japan and Germany, since these two nations stepped up their production enormously during the past few years Yet, in spite of the fact that we were at peace with all countries, the United States produced nearly one third of the world's total sulfuric acid in 1937, and twice as much as our nearest competitor, Japan, which was operating its plants at capacity in a feverish effort to end the "little Chinese Incident" Should we be drawn into war, our normal output of this chemical could be quickly increased by 50 percent.

Sulfuric acid is a compound of sulfur, oxygen, and water Since water and the oxygen in the air are free, the chief raw material which must be purchased is sulfur or a sulfide ore (pyrites) containing sufficient sulfur to support combustion

While sulfur is now obtained as a by-product in a number of industrial processes, most of the European countries are still dependent on outside sources for a considerable portion of their requirements Yet it is an interesting fact that a few of the nations ordinarily classed among the "Have Nots," are well supplied with either sulfur or pyrites. Spain, Portugal, Greece, and Norway have large reserves of pyrites, and 40 years ago Italy was the world's chief source of elemental sulfur

Since France is close to the inexhaustable supplies of Spanish pyrites, and Great Britain controls the seas, the Allies are assured adequate supplies of sulfur, and can probably prevent Germany from obtaining sulfur through her main ports On the other hand, as long as the Rome-Berlin Axis endures, and Stalin remains Hitler's friend, Germany may be able to obtain sufficient sulfur from Italy and Russia to meet her needs, provided, of course, she has the cash to purchase it.

The United States, however, not only possesses immense reserves of pyrites, but the sulfur deposits of Louisiana and Texas are the greatest yet discovered, and the annual output from these fields eclipses that of all other nations combined

When sulfur burns, it combines with the oxygen of the air to form sulfur dioxide, a stifling, choking gas, the odor of which is familiar to those who have fumigated their homes by means of sulfur candles Sulfur dioxide is capable of combining with a further quantity of oxygen, but it requires a little "urging" Therefore a third party, known in chemistry as a "catalyst," is employed to introduce this additional atom of oxygen into the compound The product thus formed is known as sulfur trioxide which, in turn, readily combines with

TABLE II
Production of Sulfuric Acid, 1937

Table compiled from figures of the U S Department of Commerce, and the "Chemical Trade Journal")

France	6.86 %
Germany	12 78 "
Italy	6.56 "
Japan	15.60 "
Russia	*7.53 "
United Kingdom	6.86 "
United States	31.00 "
All other countries	12.81 "
TOTAL	100.00 %

*Production of 1936

water to form the useful sulfuric acid

Most of the sulfuric acid is manufactured in immense lead chambers, but the pure concentrated product is made in more compact plants While most of the sulfuric acid plants have been built for the prime purpose of manufacturing this chemical, others have been erected to recover this acid as a by product And this brings us to a strange story of how our annual output of acid was *unwillingly* increased by 1,000,000 tons

Many metal bearing ores contain rather high percentages of sulfur, and in roasting or smelting such material to recover the metal values, immense volumes of sulfur dioxide were released into the atmosphere Now sulfur dioxide is a rather heavy gas and quite toxic to vegetation It gradually settled down on farms and ranches, even though they were miles away from the smelters, and caused grave damage to crops The blame was traced to the smelters, and injunctions were secured whereby their owners were given the choice of either collecting the noxious sulfur dioxide or closing down the plants They chose the first course and, although it involved heavy expenditures, they erected immense plants and turned the waste gases into sulfuric acid Instead of proving an added expense or liability, the acid collected more than paid for itself, so that in some instances it is hard to say which should now be considered the main product—metal or sulfuric acid

Under normal conditions, the production of this acid is a better index to a nation's prosperity than its output of steel and agricultural commodities, for sulfuric acid not only contributes liberally towards the production of these basic materials, but it plays an almost indispensable part in the manufacture of the innumerable things which are in such demand when times are good As an example, the year 1928 probably represented the peak of post-war prosperity, and we produced in that year 7,225,000 tons of sulfuric acid But, in 1932 when we were in the depths of the greatest financial depression of all time, our output of this acid dropped to 4,401,000 tons, a decrease of about 40 percent

The fertilizer industry is the greatest consumer of sulfuric acid, and the larger fertilizer plants usually have an acid factory as part of their equipment In 1938, this industry required over 2,000,000 tons of sulfuric acid and it was by no means being operated at capacity, or tonnage would be greater

Fertilizer is made in this plant, of which only a part is shown, by treating phosphate rock with strong sulfuric acid

The next largest consumer of sulfuric acid is the petroleum industry This acid is practically indispensable in the refining of oil, kerosine, and gasoline, yet here again, no trace of free acid is allowed in the finished products as it would soon ruin the delicate mechanism of the carbureter and score the cylinders of our automobiles In 1938, 1,120,000 tons of sulfuric acid were consumed by different parts of the petroleum industry

The next greatest demand for sulfuric acid comes from the metallurgical industries Our huge output of metal products would be impossible without its aid Mining operations could not be carried on as extensively or cheaply without the help of the high explosives which sulfuric acid is instrumental in producing, and after the various metals are separated from their ores, sulfuric acid is employed in ridding the surfaces of scale before these metals can be fabricated into such finished products as wire, bars, sheets, pipe, and tubing This acid plays an important rôle in the manufacture of electrolytic copper, galvanized iron, and nearly all types of plated metal If we had deprived the metal industries of the 850,000 tons of sulfuric acid consumed in 1938, business would have been at least partially paralyzed

Until comparatively recent times, sulfuric acid was instrumental in producing many of the other important acids used in the arts and industries Although we have discovered other means of producing these acids, the demand for sulfuric acid shows no tendency to decrease, for new uses are constantly developing elsewhere It is the main power behind the chemical industry. The consumption of this acid for chemical and medicinal purposes in 1938 amounted to 790,000 tons

Without sulfuric acid, the movie industry would be prostrated until development of some substitute to take its place in the production of the millions of miles of photographic films required The manufacture of one type of rayon would cease, and the candid camera would be relegated to the attic In 1938, 310,000 tons of sulfuric acid were employed in the manufacture of rayon and cellulose films

In the home, sulfuric acid has been instrumental in producing the heating plant, and the steel work, the steam or hot water pipes, so necessary in this system Sparkling clearness of faucet water is probably due to a compound of sulfuric acid, (alum), which is introduced at the filtration plant to precipitate or throw out suspended impurities This same acid has had a hand in the manufacture of keen edged razor blades, and is responsible in part for the chromium plated fixtures of the bath room

Soap, made by the so-called "English process," and shoe polish, whether black or white, have probably been manufactured by the aid of this chemical

Without sulfuric acid there would be no family car Practically every part of the modern automobile, (with the exception of the glass), has been manufactured by the aid of this chemical The steel of the body, as well as the numerous metal parts, must be "pickled" in sulfuric acid before the finish is applied The nitro cellulose lacquer is produced through its agency, and the chromium plating also involves its use. Even the upholstery, whether it be of wool or artificial leather, has been produced by the aid of sulfuric acid or its derivatives

We owe our thanks to sulfuric acid for the enamel ware in the kitchen, certain ornaments in the living room, many of our paints and pigments, and for numerous dyes which impart beauty to the textiles used throughout the home The cans on the pantry shelf have been manufactured by the aid of the acid

Devoutly do we hope that American made sulfuric acid need only serve our peace time wants, but this nation's watchword is "Preparedness" and therefore, our resources for producing this acid are being mobilized to meet any emergency The output of sulfur has already been increased, new deposits of pyrites are being exploited, new trade routes established, and new acid plants erected This "Chemical Giant" of our constructive industries must be groomed to defend and preserve these industries should war be thrust upon us.

INDUSTRIAL TRENDS

Competition for Swedish Steel

TROUBLE in Scandinavia has upset other industries than those using wood pulp—paper and rayon producers. Cutting off of Swedish steel from world markets has given the razor blade industry a rude shock. Practically all so-called wafer blades are made of Swedish steel regardless of brand name.

Steel imports for blades run several thousand tons annually, and while this is a small item as steel tonnages run the product is a premium one. Now, for the first time in history, American steel producers have a chance to capture this market, if they can do it. One concern has been working several years to develop a suitable competitor for the Swedish product and is now in production. Another slowly gets underway.

While almost anything can happen in the European situation, day-to-day news promises no prompt resumption of imports. Couple this with the lack of any substantial inventions in the hands of manufacturers and it spells an eventful dependence upon domestic mills—with quality in the balance.

England and Germany have been large producers and exporters of blades to world markets. Lick the steel problem and much of this business should gravitate to American manufacturers.

Prefabrication Boosts Plywood

WHEN the prefabricated house turns the corner, it will be found that plywood, not steel, is the favored structural material. Plywood has high strength, light weight, insulating properties, and handles with ease. These qualities spell thin walls and partitions, with savings in weight and cost, and ease in shipment. Steel, while providing high strength, has been abandoned by most prefabricators because of weight, lack of insulating properties, and the need for paint protection to prevent corrosion.

Chiefly responsible for the greater interest in plywood is the advent of the phenol formaldehyde resin binder, which holds the laminations of wood together, and makes the product suitable for exterior use. The resin bond is indestructible and is anathema to fungi and termites. Panels so bonded and kept under water for two years show no sign of separation even when the wood itself becomes waterlogged.

The prefabricated house is still coy about making a stage appearance, but the possibilities are much better today than they were four years ago when there was so much chatter about it. Out in front is a concern which offers all-factory made houses in nine standard sizes, but so skilfully designed as to afford a much wider style variety. About 500 were sold and erected last year, this year, with a lower priced model, production may be doubled. Merchandising covers more than a dozen states and the company operates at a profit. This sums up to being a business and not an experiment. It shows what can be done.

Trailing this concern are several smaller ones, but none which meets so completely all the definitions of prefabrication. Some employ partial factory fabrication, others limit their operations to local developments. Most advocates of steel have shifted over to production and sale of framing and panels for industrial rather than housing use.

Prefabrication has had many obstacles to overcome and there are several hurdles yet to take. Early design was unattractive, costs offered very little, if any, advantage over orthodox construction, and strong resistance was met from every element in the building trades from labor on up through supply firms and contractors, to engineers, architects, financiers and public agents, short of the Government. Design is now pleasing, costs favor factory work, but there is still sabotage. This is unlikely to be banished until the force of public demand sweeps it out of existence.

Approach to the problem has also delayed maturation of prefabrication. Most experimenters have been persons seeking new outlets for old materials. Thus, steel producers struggled to get steel houses on the market, while plumbing and electrical supply concerns hastened to find a box suitable to encompass their products. Only by consideration of housing and prefabrication needs first and then selecting materials to do the job, has the barrier to success been broken.

Proof of this is found in the experience of companies. The top flight prefabricator, for example, spent eight years discarding pre-conceptions. Having tried metals, plywood was adopted, and it is not applied in typical building manner, but skin stressed a la airplane. That is, plywood panels are bonded to the frame with resins to make them load carrying members. Likewise, standard heating equipment was found unsuited and new types developed.

Manufacturers who are actually in production declare that prefabrication has outgrown the "nut and bolt" stage of development, that further preoccupation with technical matters will not accelerate the low-priced housing movement. While much remains to be done, basic problems of construction, they say, have been solved with enough practicability to warrant placing major emphasis upon business building with more attention to consumer taste, merchandising and wide promotion.

This attitude is reflected in the statement of one producer who says: "The automobile is our chief competitor. When we can offer the consumer as attractive a piece of merchandise with equally definite figures of first cost and upkeep, then we'll begin to have a business. The country isn't breathlessly awaiting the prefabricated house. It must be sold."

If prefabrication continues gains of the past two years what will it mean in material sales? A great expansion in the use of plywood, a scramble to design and place on the market more compact and economical plumbing, heating, air conditioning, and electrical fixtures, in which activity wide awake, small companies can play an important rôle. It will mean also an expanding market for all household effects which go to make up a livable home.

When mass production means thousands instead of hundreds of new homes, it will pay to try to find something superior to plywood for walls. A really low cost plastic is wanted for panels, or, perhaps, something fashioned from farm products or wastes via the chemurgic road.

—*Philip H. Smith*

INSECT QUARANTINE

Pacific Plane Service Provides Passage for Insect Pests . . . Hawaiian Farms Threatened . . . Midway and Canton Islands Have Pest Control Stations

THE United States may have to face an invasion which all the big guns of our Army and Navy cannot repel. The foe is an army of insects. While transpacific plane service brought this country into rapid communication with the Orient, it also brought a threat of devastation. Plane service, smashing the barriers of time for man, has been quite impartial about man's enemy, the insect.

In the old days, the slower journeys by steamer and sailing vessel were tough on insects with the urge to travel, for the usual insect's life cycle is so brief that few could last out long ocean voyages on ships.

Occasionally, however, insects did manage to survive trips, and the farmers of Hawaii saw and suffered from the destruction caused by the pests. Planters of sugar cane, Hawaii's most important crop, early came to know the need for insect quarantine. They organized and created an experiment station, staffed by agriculturists expert in battling the diseases of sugar cane and insect pests.

Through the knowledge of these entomologists, Hawaii's sugar industry learned how to cope with insect enemies, to liberate in infested fields natural parasites to prey upon the pests, to re-establish nature's balance, and to defeat the invading hordes. But it learned also how difficult it was to bring insect allies from far countries to the Islands -- for the time interval for the voyage was as much a bar to parasites as to pests.

WHEN Pan American Airways laid out its route for Clippers to and from the Orient, the scientists of the Hawaiian Sugar Planters' Association urged that quarantine measures be adopted. With the permission and co-operation of PAA officials, a quarantine station was set up on Midway Island. An entomologist was sent to inspect, search, and spray all planes arriving at that island. Experience has proved that the defense was sound.

In the course of a recent 10-month period, 66 planes were searched at Midway. More than 1200 insects were found to have died before arrival. But the search yielded nearly 1100 live ones which were promptly placed in the scientists' poison bottle. It seemed that danger from the Orient was definitely halted.

But the threat has reappeared in another quarter. Pan American has surveyed a route from Auckland, New Zealand, to San Francisco, via New Caledonia, Canton Island, and Honolulu. The first regularly scheduled flight will follow approval of the route by the Aeronautical Commission at Washington and is expected to take off this year. Forewarned by experience on the Orient run, Pan American Airways, together with the Hawaiian Sugar Planters' Association, have already taken steps to set up a second quarantine station on Canton Island for the new route.

The reason for selecting Canton, an uninhabited atoll nine miles long and half as wide, is not apparent at first glance, but it is a sound choice. Canton is the intermediate landing point for Clippers flying between New Caledonia, a potential plague spot of the South Pacific, and Honolulu, with its 154,476 population. Canton, however, has no human population, little vegetation, and few insects. Hence, it becomes an ideal spot for a protective quarantine control. By the time the Pan American Clippers are ready to begin their flights, the HSPA bug man, already appointed, will be on hand with his sprays, and any insect stowaways heading for Honolulu will be summarily executed at Canton.

The same speed which enables insect pests to survive long trips in planes, permits importation of insect parasites (in special cages, as shown above) to fight them

SANDIA MAN

Artifacts Found in Basal Layers of a Cave in New Mexico Give Evidence of Earliest Known Man in America . . . But Just Who Was That Man?

By FRANK C. HIBBEN
Museum of Anthropology The University of New Mexico, Albuquerque

THE archeological bird, which always flies backward because it doesn't care where it is going but wants to see where it has been, is again on the wing A recent discovery in a New Mexico cave has pushed back the history of the first Americans still further into a shadowy past

Both North and South America have long been forced to take seats in the background whenever the question of the antiquity of man has arisen Our predecessors of Europe who killed the mastodon and grappled with the cave bear are well known, and every grammar school child is familiar with their appearance and their tools The New World, however, has not been able to boast of 50,000- or 100,000-year-old ancestors with hairy skins and protruding jaws Instead, we on this side of the Atlantic have to be content with a moderate background of antiquity and with human beginnings derived second hand from the Old World by means of migrations across the Bering Straits

It is for this reason that the discovery of a cave habitat of ancient hunters in New Mexico has been followed with much interest by anthropologists These early Americans give promise of being the earliest inhabitants yet discovered in North or South America and comparable in age with some of the European oldsters

In the Sandia Mountains, near Albuquerque, New Mexico, three years ago some archeologists were crawling through a limestone cave of unusual length In the dust and debris of the cave floor one of them scuffed up a bit of bone — a piece long and curved and sharp on one end This was the claw of a giant sloth which had ambled over these limestone hills some 10,000 to 20,000 years ago Since this initial discovery, the Sandia Cave has been the scene of much activity Flickering torches and acetylene lanterns have sent shadows dancing in gloomy corridors where the sloth laired in by-gone ages The chambers and passages of the cave have reverberated with the clang of the sledge and pick and the rattle of wheel barrows

Gradually there has come to light a human story which could be pieced together from evidence gathered during the last three years in this cavern home. Here there was a fire hearth with the blackened fragments of a camel jaw beside it, though many thousands of years have elapsed since the camel, which originally evolved in the New World, was native to the Southwest Dart points were scattered among the broken bones of the animals which had been killed, perhaps, with these same points Scrapers and knives of flint and bone splinters broken for the marrow gave evidence of Sandia hunters and their domestic life A cave man of ancient America gradually took form.

This, in itself, is not remarkable, for evidences of a very early type of American who had hunted now extinct mammals and who lived during the rainy period just after the last glaciation have been found before Of these, one of the most famous is the so-called Folsom Man, named from the little town of Folsom, New Mexico Folsom Man was a hunter who ranged up and down the foothills of the Rocky Mountains hunting a peculiar type of bison or buffalo now long extinct This type of man left traces of his passing in a distinctive type of javelin point which looks like a short bayonet with a groove running up either side These Folsom points have been found from Saskatchewan to Texas and for the last decade have been considered as indicating the earliest known human evidence in the New World

A vertical section of the deposits in the Sandia Cave. Numbered layers indicate *1*, the crust that sealed in the deposits below. *2*, Folsom breccia. *3*, yellow ochre *4*, the Sandia layer (note point found in place)

AT first it was thought that the Sandia evidence was only another phase of the Folsom a variation perhaps, or another tribe Results of the latest digging has, however, given conclusive evidence of a group of men who hunted the green hills of New Mexico long before even Folsom Man These were contemporaries of the mammoth and the mastodon, and of the American horse and the camel and the savage predators who preyed upon them Evidence of these earlier animals is not founded on guesswork or even on clues, but is based on the science of stratigraphy Stratigraphic evidence is derived from the long-known fact that he who is first gets in on the ground floor. Thus, if we dug in New York, we would find the relics of the Gay Nineties buried in the city dump below the more modern remains of our own era We would correctly conclude that the battered remains of the horse car represented an earlier vehicle than the automobile which lay above it The joker in the stratigraphy is, of course, in the difficulty of finding remains which overlie one another. If, instead, the deposits are side by side, no matter how primitive or advanced one

or the other might be, it is difficult to establish the precedence of one over the other conclusively.

The Sandia Cave, happily, is well stratified. On the top surface throughout the cave is a heavy deposit of dust, bat guano, and broken fragments fallen from the roof. Mingled with this dust at the front of the cave are fragments of pottery, baskets, and yucca sandals of the Pueblo era. Below the uppermost layer of dust is a crust of stalagmitic material some three to six inches thick (marked *1* in the photograph). This records a period when the cave was wet and when water containing calcium carbonate in solution dripped from the ceiling and spread out over the cave floor in a sheet which was deposited as the water evaporated. Under ordinary conditions only a fraction of an inch of this material is formed in a century. More important than its possibilities of indicating age in the cave, it was effective in sealing in the deposits below it, and thus prevented any mixture of recent material with the ancient which lies beneath. Thus the remains of extinct mammals and the cultures which accompany them have been completely enclosed and unaffected by disturbing influences until the sledge and the pick of the archeologists broke through.

THE geological epoch just prior to our own is called the Pleistocene. This time was characterized by the formation of great sheets of ice in Continental glacier form in both North America and Europe. The fauna of the Pleistocene is extremely distinctive, insomuch as most of the species then extant are now extinct. Wet periods accompanying these glacial times made great changes in areas now dry. The mammoth grazed amidst plenty on slopes which are now barren and rocky. The stalagmitic crust in the Sandia Cave is evidence of one of these wet periods when the hill above the cave was deluged with rains and snows now unknown there. All material below this crust is Pleistocene in date. No mammal bone or fragment of Pueblo culture occurs below this level.

Immediately beneath the calcium carbonate capping of the cave lies a thick layer — the one marked *2* — of debris, dirt, and bone fragments consolidated into a homogeneous mass by the same material as the capping above. This consolidated material is a great flat hasty pudding in which are mixed ingredients which were lying around on the cave floor in the late Pleistocene. There are fragments of bone and teeth representing the garbage piles of beasts and men. Pieces of rock of all sizes are covered with dust blown or carried in from the cave entrance. Chips of flint, scrapers, and points are consolidated in this material as though liquid cement had been poured over the whole to make sure none moved from the positions they had assumed during the Pleistocene. Most interesting is the fact that the projectile points in this material are true Folsom type. Evidently the Folsom bison hunters occasionally used the cave when on trips in the vicinity, and lost or left them there.

Above: Stone scrapers and gravers of Sandia man, also javelin points. *At left:* A Folsom point, the darker object, not the brighter one, found embedded in a matrix near a bone of a camel, proving their contemporaneity

Beneath the Folsom layer lies a thick deposit (marked *3*) of yellow ochre stratified in laminae and evidently water laid. This, then, represents a second or earlier wet period in the cave's history. At this time the drip and trickle of the cave waters were not disturbed by any inhabitants or visitors. The sloth shunned the mud and slime of the cave floor, and so did man as well, for there is no indication in the ochre layer of any disturbance or any casually dropped implement or bone.

Below the ochre and between it and the solid limestone of the cave floor are the most important deposits of the cavern (marked *4*). These were accumulated during a dry period, the first in the varied history of this abode. In these lowest levels there was again evidence of grisly meals, bone fragments, fires, and flint implements. These latter are javelin points entirely different from the later Folsom variety. They are notched from one side, forming a single shoulder in a manner very similar to flint points of the Paleolithic or Old Stone Age of Europe. That the Sandia points may be comparable with some of the earliest implements of Europe is a distinct possibility.

European remains of the Paleolithic variety were made mainly by types of men having certain primitive characteristics. They walked with a stoop-shouldered, bent-kneed gait. Their heads were fastened on their necks far forward, like those of a gorilla, and their jowls protruded while their foreheads receded. Such a type of man as these has been eagerly sought for in the New World since scientific endeavor in Europe began. So far, there has been no success. First, Folsom Man and now Sandia Man, seemed to give promise of being this American link. The probable truth is that even such an oldster of the last of the ice age as Sandia Man would look no worse if we saw him on the street than some of the least attractive of our politicians. Yet, in order to satisfy a perfectly natural as well as scientific curiosity, we would like a look at Sandia Man's bones — if only he has left one of his dead in a corner of the cave, and if the rats have spared him sufficiently so that we can see his outline. Such a discovery would solve one of the most pressing of the queries concerning the mystery of the first Americans. That Sandia Man lived, loved, hunted, and died in the time of the mammoth and the sloth we now know. Perhaps the as yet unexcavated portions of the cave will answer the questions of his appearance.

●

Readers will note that, in the case just described, the evidence calling for Pleistocene antiquity is based on stratigraphic grounds. In all too many of the instances where claims of high antiquity were made these were based on finding human artifacts associated with bones of animals that lived in Pleistocene times — and nobody yet knows how much longer toward or even into our own era. —The Editor

Is Atomic Energy Nearer?

Physicists Talk Down Some Fabulous Claims . . . But New Findings May Alter the Picture . . . Prediction Probably Unsafe . . Immediate Development Unlikely

By ROY H. COPPERUD
University of Minnesota

EYES of the scientific world — and of a good part of the lay population, too — widened the first week in May at the startling news that work of a 28-year-old physicist at the University of Minnesota in isolating the explosive uranium isotope, U-235 had been corroborated, marking a significant advance toward shackling atomic energy

The physicist is Dr Alfred O C Nier who modestly expressed dismay at extravagant reports which blossomed on front pages everywhere, to the effect that the incalculable forces of the atom were on the verge of being pressed into the service of mankind

There were fabulous predictions that this discovery made feasible bombs of unheard of strength, that five or ten pounds of U 235 would propel a vessel around the world for an indefinite time without refueling — in short, that economic foundations of the world were about to crumble

The fact of the matter he insists, is that many a knotty problem remains to be solved before any useful harnessing can take place Chief among these is extraction of U-235 in vastly greater quantities than is possible now

Yet authorities in the field concede that the discovery is a stride of unprecedented importance toward opening up a new and virtually limitless source of power Dr Nier himself admits that large-scale extraction 'is surely within the range of possibility "

It was the work of Dr John R Dunning at Columbia University in New York, aided by Dr E T Booth and Dr Aristid V Grosse, that clinched the findings of Dr Nier The New York physicists subjecting Dr Nier's infinitesimal samples of U-235 to a slow neutron bombardment, confirmed successful isolation of the isotope, and demonstrated its explosive properties

For about a year previous to last February, when Dr Nier first accomplished the separation, it was known that uranium would blow up if bombarded with slow neutrons, releasing immense energy Discovery of this fact was made by two Germans, Dr Otto Hahn and Dr Lise Meitner, in Berlin

The explosions, however, were incomplete and the results baffling Baffling, that is, until a theory was advanced by Prof Niels Bohr, Nobel prize winner at the University of Copenhagen, and Dr John A Wheeler of Princeton University, that U-235, one of the three isotopes which constitute uranium, was responsible

This was only a hypothesis, albeit a good one, until Dr Nier blazed the trail in separating U-235 from its brother isotopes, U-234 and U 238 Sieving them out in a mass spectrometer, he obtained quantities sufficient for testing These were sent on platinum collecting plates to Columbia

WHAT happens in the bombardment is that slow neutrons crack U-235 atoms as a baseball bat would crack a walnut, splitting them in two Accompanying the explosion is a terrific release of energy Particularly significant is the fact that, in a quantity of U 235, the process is cumulative, for the smash sets free other neutrons, which in turn attack other atoms Once begun, the process will continue automatically — a "chain reaction "

When natural uranium was first bombarded, the explosions did not continue in this fashion because of the great preponderance of U-238 The stray neutrons which would keep the action going in pure U-235 collided with atoms of U-238, which are unaffected by the slow barrage that shatters U-235 Consequently, there was an effect of smothering Even with pure U-235, a considerable amount would be required, for many of the neutrons fly off harmlessly into the air

Dr Nier estimates that one pound of U-235 would generate as much force as the combustion of 2,000,000 pounds of coal, or that its detonating energy would be equivalent to that of 20,000,000 pounds of high explosives

All of which sounds vastly encouraging [and just at present in some aspects a bit alarming —Ed]—except that the greatest amount of the isotope that he has yet been able to produce is less than a microscopic 1/100,000,000 of an ounce

It was formerly believed that U-235 made up only one part in 1000 of natural uranium The occurrence of the explosive isotope is actually far more frequent than that, however, for Dr Nier's instruments showed a proportion of one U-235 atom to every 139 of U-238, another of the trio Thus natural uranium contains seven times more of U-235 than had been supposed

Dr Nier's separation work was duplicated by Dr K H Kingdon and Dr H C Pollock of the General Electric Company's laboratories, and their samples produced the same result in the Columbia cyclotron as those isolated at the University of Minnesota

Rumors said that the discovery had set all available researchers in Germany at work in the Kaiser Wilhelm Institute at Berlin to seek a means of economically extracting U-235 in commercially usable amounts Large deposits of uranium are found in Germany, also in Canada the Belgian Congo, England, and Colorado

Dr Nier estimates that even with any reasonably economical means of extracting U-235 in large quantities the cost per unit of energy produced would equal that of coal "So you see," he observed, "it would not mean getting power for nothing " Despite the extraction cost, the great amount of energy concentrated in a small volume would make it invaluable for airplanes, for example, or any other apparatus where weight of fuel is a consideration

The Minnesota scientist considers it hardly likely that the mass spectrometer, the device he used to separate the uranium isotopes, can be adapted to mass production It is more probable that some chemical means of separation would turn the trick But as to any such method, researchers are still at sea Dr Nier emphasized further that, once extraction is accomplished, the problems of handling and chaining the atomic force safely might occupy scientists for years

This is the abbreviated story of what may well prove to be one of the great crests of scientific achievement True, researchers are cautious about advancing ambitious claims, and Dr Nier himself believes that remaining obstacles to chaining atomic power will persist far into the misty future But only ten years ago it was considered impossible to separate the isotopes of any element whatever, and now it is being done commercially with hydrogen.

BROWSING with the Editor

THROUGH THE SCIENCE LITERATURE OF THE WORLD

SYPHILIS IN U. S. The annual attack rate of syphilis per 100,000 people in the United States in 1935 was 796, compared with 47 in Great Britain (clinics only), 20 in Denmark, and seven in Sweden —*The Journal of the American Medical Association*, *114*, 1321 (April 6, 1940)

SA

CELESTIAL MECHANICS —The mathematical theories of the celestial motions are of a complexity almost beyond conception, and the length of some of the calculations involved is appalling. Single formulas that fill dozens of printed quarto pages, series expansions in which hundreds of terms must be used, and single calculations that require years to accomplish, are not unusual in celestial mechanics. Edgar W. Woolard, *National Mathematics Magazine* (January 1940)

SA

DON'T BLAME THE RAZOR. The average man, "cussin'" his razor blade roundly, doesn't realize that each hair's breadth of blade edge has to cut 100 hairs in a once over shave or 200, twice-over - E. J. Casselman, Mellon Institute of Industrial Research

SA

OIL PAYS - Nearly one twelfth of all the carload freight revenue of American railroads in 1939 was paid for the transportation of petroleum products. Interstate Commerce Commission

SA

AUTOMOTIVE COSTS - The typical wage earning, car owning family spends $197 74 annually to operate its car for business and pleasure. U. S. Bureau of Labor Statistics

SA

INSULATION SAVES. United States Government tests on identical houses, one insulated and one not insulated, showed a fuel cost for the insulated house 44 75 percent lower than that for the non insulated. National Warm Air Heating and Air Conditioning Association, 11 West 42nd Street, New York

SA

WAR AND PAPER —American paper makers regularly import from Scandinavian countries more than one fifth of the pulp they need, with Sweden leading among suppliers —*Science Service*, (April 11, 1940)

SA

LONG RAYS WEAK.—Suggestions that long, invisible infra red radiation could be used to pierce fog have been refuted by experiments —J. A. Sanderson, U. S. Naval Research Laboratory, Washington, D. C.

SA

INSECT ENEMIES —Throughout the world, there exist nearly 500 plants that are carnivores, or insect eaters - Brooklyn Botanical Garden, Brooklyn, New York.

SA

"HYPODERMIC."—Oil squirted at high pressure from tiny holes, such as those in Diesel injectors, often penetrates the flesh of workers. Though the oil penetrates to a considerable depth, the worker is not immediately aware of his injury.—Dr. G. Failla, Memorial Hospital, New York.

BETTER SHOOTING - During the recent war between Finland and Russia, the average number of shots fired for each airplane destroyed was 54, contrasted to 11,000 shells needed to bring down each airplane at the beginning of the World War and 6000 shells at the end of that War. *The Illustrated London News*, (April 13, 1940)

SA

SPARKLESS - To prevent generation of static sparks by belting, one powder manufacturing company keeps belts in a moist condition by frequent applications of 50 percent glycerol and 50 percent water. *News Edition*, American Chemical Society, *18*, 355 (April 25, 1940)

SA

PETROLEUM RESEARCH. The growth of research in the petroleum industry has been more rapid than in most industries, having expanded 639 percent in 11 years and having risen from seventh largest to second largest. For every 10,000 wage earners in the petroleum refining industry there are 563 research workers, almost twice as many as in the chemical industry which is reported to have the next highest concentration. *News Edition*, American Chemical Society, *18*, 347, (April 25, 1940)

SA

PROVED SUPERIORITY. The aluminum mirror coating of the 100 inch telescope at the Mount Wilson Observatory lasted five years and was recently renewed. Silver coatings, formerly used on telescope mirrors, lasted only a few months - *Publications of the Astronomical Society of the Pacific*, *52*, 145, (April 1940)

SA

OIL UNLIMITED. It seems altogether likely that nature is continually producing more oil underground, perhaps at a faster rate than gas pressure or pump stroke can bring it to the earth's surface.

Dr. Gustav Egloff, Universal Oil Products Company, Chicago, Illinois.

SA

CHINCHILLA FUR - Eleven chinchillas were brought from South America 17 years ago. Though difficult to breed in the United States, the original group has grown to 3500, 2000 of which are located in the home chinchilla ranch in California, while the remainder are scattered throughout the country - Trane Company, La Crosse, Wisconsin

SA

FAT PEOPLE. The old belief that women can withstand cold better than men has been proved correct by calorimetric measurements made on nude men and women at the Cornell University Medical College. It was shown that, if men were by nature provided with a layer of fat tissue about one sixth of an inch thick, they would be on a par with women in heat retention —National Academy of Sciences, *Abstracts*, Annual Meeting, 1940

SA

HEAT DEATHS —In 1939 more persons died from heat stroke indoors than out. The exact percentages were 67 1 percent in the home, 22 percent in factories, and 10 9 percent in public places. The reason is simple. Both the very young and the very old—most susceptible to heat—spend more of their time indoors than do others —National Warm Air Heating and Air Conditioning Association, 11 West 42nd Street, New York

Bleak Black Ball Of Rock

After Ten Years the Planet Pluto's Mass Has Been Determined . . . Denser, Darker, More Massive than Was Expected . . . Laborious Computations

By HENRY NORRIS RUSSELL, Ph.D.
Chairman of the Department of Astronomy and Director of the Observatory at Princeton University. Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington

A PROBLEM which looked as if it might remain unsolved for many years has been cleared up recently by Professor Brouwer of Yale—who reported his results at the last meeting of the Astronomical Society. Ever since Pluto was discovered, attempts have been made to find its mass—and previously with no success.

The problem is simple enough in principle, though very complicated and laborious in detail. The attraction of Pluto upon the other planets modifies, or "perturbs" their orbits, by an amount proportional to the attracting force, and hence to the mass of Pluto itself—which can be found, if we can determine from observation the actual magnitude of these perturbations. Given precise information about the orbits of Pluto and any other planet—say Neptune—the calculation of the perturbations can be made by standard methods—none of them simple, because the problem is inherently complicated mathematically. There are two main lines of attack—the "general" method, which derives formulas from which the perturbations can be calculated at any time, and the "special" which determines their effects only for a given interval of time.

The first is enormously laborious, especially when, as in the present case, the orbits are eccentric, inclined, and come relatively near one another. When the results have been obtained, they are applicable almost indefinitely. Hence these methods alone are of value for the Moon, the satellites of Jupiter, and the inner planets, which have already been observed over hundreds or thousands of revolutions.

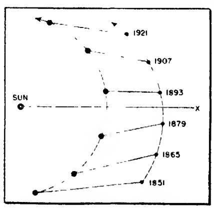
The second method calculates step by step, giving accurate values over the interval of time covered by the computations, but tells us nothing about the future until the calculations have been extended to cover it. For two or three revolutions, or less, this second process costs less work than the first.

The two methods follow entirely different mathematical paths—diverging at the start and meeting only at the finish—so that, when both have been applied to the same case, they afford a very complete check upon one another.

The perturbations of Neptune, for example (except those due to the undiscovered Pluto) were calculated by Newcomb 40 years ago. A recalculation by the second method has just been made by Brouwer, using modern "punched-card" calculating machines, which save a great deal of time and money. The results of the two methods agree excellently, over 160 years, except for a regularly recurring deviation in longitude, of maximum amount 0″.15 with a period of 12.8 years, exactly that in which Jupiter catches up with Neptune. A term of this period appears in Newcomb's tables, and it is clear that, despite the great care taken by this distinguished investigator and his assistants, some numerical error must have crept into its coefficient. Recalculations are being made by the first method.

THE perturbations due to Pluto can be calculated, just as well as for any other planet, but when the attempt is made to use them to find Pluto's mass, a new complication arises.

We must find, from the observations of Neptune, not only these perturbations, but the size and shape of its orbit. If Neptune had been observed all around its orbit for several revolutions, like Jupiter and Saturn, we could determine the orbit almost independently of the perturbations, since these would be different in successive revolutions, and almost average out. But Neptune was discovered in 1846, and has been only a little more than half-way round the Sun since then. Consequently, when its motion is perturbed by Pluto, it is possible to find another orbit, such that a planet moving in it, and not subject to Pluto's attraction, would simulate very closely the motion of Neptune in its real orbit, disturbed by Pluto. The motions of the real and fictitious planets would diverge in the unobserved parts of the orbit—but this leaves us no wiser, though our grandchildren will be. The existing orbits of Neptune, calculated, without taking account of Pluto, so as to fit the observations as closely as possible, are of this "fictitious" type, and it is only from the differences between the observed positions of the planet and those calculated from these adjusted orbits that we can find out how much influence Pluto really exerts.



Positions of Neptune and Pluto, projected on plane of Neptune's orbit

This matter was thoroughly discussed, a few years ago, by the late E. W. Brown. He concluded that it was not at present possible to obtain a reliable determination of Pluto's mass, either from observations of Neptune, for the reasons aforesaid, or of Uranus, which is too far from Pluto.

Brown, however, considered only the longitudes of the planets. The latitudes—measured, if we will, from the mean orbit plane—usually suffer much smaller perturbations—since all the planets move in nearly the same plane. But Pluto's orbit has the high inclination of 17 degrees to the ecliptic, or 15½ degrees to Neptune's orbit, and this puts it far out of the general plane of the system.

The situation is illustrated in the sketches. The first represents the positions of Neptune and Pluto during the interval of observation as projected on the plane of Neptune's orbit. The planets were in conjunction in 1892, at a distance of 19 astronomical units, and have been closer together than the average over the whole time.

The second sketch represents the planets as seen from afar perpendicular to the plane of Neptune's orbit, along the line *Sun-X* in the first. From this point Neptune would appear to oscillate back and forth in a straight line passing through the Sun, while Pluto, during the interval of observation, was continuously on the south side of the orbit plane.

The attraction of Pluto on Neptune throughout this interval tended to pull Neptune away from the Sun, as is evident from the first sketch, but, as has been explained, the principal influence of this will be to alter the calculated elements of Neptune's orbit. But the component of attraction at right angles to the plane of Neptune's orbit tends to pull it out of the plane. No adjustment of the assumed orbital elements can do much to help this, for, in the absence of perturbations, the orbit must be exactly plane. (The actions of the other planets can be accurately computed and allowed for—after which they may be ignored, and only Pluto considered)

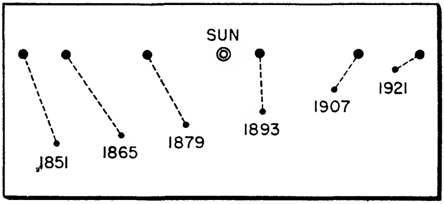
After making the best adjustment of the calculated plane that we can, we may expect to find Pluto south of this plane at the beginning of the observations, north of it in the middle, and south again at the end This is exactly what Dr. Brouwer has found, after making just such calculations In 1850, Neptune was 0″5 south of the calculated position, in 1900, 0″.2 north of it, and, in 1936, 0″4 south. Though there are some fluctuating errors in the observations—as is inevitable—the general trend is unquestionable

MEASURABLE effects of the attraction of Pluto on Neptune have thus been found From these Brouwer finds that the mass of Pluto is 1/400,000 that of the Sun, or 83 percent of the Earth's, with a probable error of eight percent

The perturbations in longitude, between 1846 and 1936, are almost completely obscured by the adjustment of the orbit But two earlier observations of Neptune exist Lalande, in 1795, while cataloguing faint stars, made two observations of the planet supposing it to be a star. These agree well with one another, and give a residual deviation of 10″ in longitude from the orbit adjusted without regard to Pluto If perturbations by Pluto, with the mass determined from the latitudes, are taken into account this discordance disappears By itself, this deserves no great weight, as Lalande's observations were not of high accuracy; but the agreement of the two determinations is satisfactory.

Dr Brouwer is investigating Uranus by similar methods Here the attraction of the Sun is greater, and that of Pluto less, but it will be of much interest to learn what can be derived, especially from the latitudes, but it is improbable that the results will compare in accuracy with those already derived from Neptune.

The mass of Pluto thus takes its place in the list of known data for the solar system. It is surprisingly great—equal, within the limits of error, to that of Venus, which is 1/410,000 of the Sun's. It is not the actual value which is surprising—we have no excuse for any



Neptune and Pluto, projected on a plane perpendicular to Neptune's orbit

anticipations on the mere knowledge that a trans-Neptunian planet exists But the faintness of Pluto suggests a much smaller value

If Venus could be put at Pluto's average distance from the Sun and Earth at opposition, a simple calculation shows that it would appear as a star of visual magnitude 11 8 The measured value for Pluto, reduced to the same standard conditions, is 14.7 Hence Pluto reflects only seven percent as much light as Venus would if put in his place If of the same size as Venus, his reflecting power, or albedo, must be correspondingly small Now the albedo of Venus has the high value 0 59, but, even so, that of Pluto comes out only 0 04 This is so very low that the planet's surface would be called dark gray, or almost black (not brown, for Baade's observations show that, unlike the Moon, the light which it reflects is of the same color as direct sunlight).

The Moon itself reflects seven percent of the incident light If it were not for the weakening of the light of the half moon by the shadows of the innumerable roughnesses on its surface, this value (which represents the average for light reflected in all directions) would be raised to 10 or 12 percent We see Pluto at the full phase hence it may be concluded that, if it is of the same size as Venus, the average reflecting power of its surface is probably between 30 and 40 percent of the average for the Moon

This is clearly not impossible, for the darkest spots on the Moon are made darker than the average, but it is about at the limit of plausibility

We cannot well escape the difficulty by assuming that Pluto is smaller than Venus, though of the same mass, for this would make it denser, and Venus, with a mean density 4.9 times that of water, is denser than any other planet except the Earth.

TO assume that Pluto was twice as dense as Venus would be going wild —making its mean density greater than that of the core of the Earth, composed of metal under enormous pressure. But even this would raise the calculated albedo only to 0 06

There seems to be no escape, therefore, from the conclusion that the surface of Pluto is almost black This is the more remarkable because Pluto, like Venus or the Earth, ought to be able to retain an extensive atmosphere. It is reasonable to suppose that, like these planets. Pluto lost any hydrogen which its atmosphere contained early in its career But an atmosphere which contained water-vapor like the Earth's, or carbon dioxide like that of Venus, would, at the very low temperature of Pluto, send these substances down in permanent snow Nitrogen and the inert gases would remain to form a permanent atmosphere, even at this temperature; but, if this atmosphere were of any considerable extent, it would scatter enough light on its own account—like the sky—to make Pluto look much brighter and bluer than it is It appears, then, that Pluto is an atmosphereless ball of black rock

All this depends on Brouwer's determination of the mass, but the evidence for this is so strong that it altogether outweighs considerations based upon the supposed improbability of conditions which certainly do not appear to be physically impossible.

Neptune's satellite, sometimes called Triton, is of very nearly the same brightness as Pluto—or, at least, it would be if the two bodies could be observed at the same distance, which will happen about 1989, when Pluto is in perihelion The satellite's mass has been determined by Nicholson, van Maanen and Willis by observing the small oscillation of Neptune's position about the center of gravity of the system as the satellite describes its orbit They find a value about one twelfth of the Earth's mass, or one tenth of Pluto's Allowing for a slightly lower density, we may estimate that Triton has about half the diameter of Pluto, and four times its albedo. The difference between the two bodies is surprising, and illustrates the danger of guessing at the mass of a planet or satellite from its brightness — *Princeton, May 4, 1940.*

Seeing With Electricity

New Electron Microscopes Now Being Developed Far Outdo High-Powered Optical Microscopes . . . Reveal a World Hitherto Unseen by Man

By JEAN HARRINGTON

IN this age of super-movies, super-telescopes, super-cyclotrons, and super-whatnots, we are apt to pass over lightly the news that a super-microscope has just been built But such news has just popped out of New Jersey, following within a year two similar announcements from Canada and Germany; and to anyone interested in the progress of science, it sounds a good deal more important than the latest super-movie

The electron microscope already has become a powerful and a practical instrument. With it, science can explore

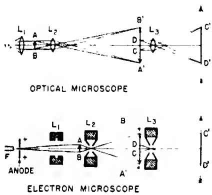


Figure 1 **A comparison of the optical and electron microscopes. The one does its ray bending with glass, the other with magnetism from the coils L_1, L_2, L_3, explained in text**

a new world of things infinitely small—disease viruses, for example, which have never before been seen or photographed—and this may lead to important medical discoveries

We are all of us familiar with the ordinary optical microscope Perhaps we have used it in the laboratory to see the teeming life in a drop of pond water, or to study the fragile nerve endings in the tissue of a frog's leg. The upper part of Figure 1 shows how such a microscope works The object or specimen—suppose it is our drop of pond water—is represented by the short arrow *AB*. It is brightly illuminated, light from the lamp is concentrated on it by the lens L_1 The lens L_2 bends the light from the object and focuses it to produce an enlarged, inverted image of the water drop at *A'B'* Then the lens L_3 takes light from any part (such as the section *CD*) of the first image—a single amoeba, perhaps, swimming sluggishly in the drop—and re-focuses it to give us a still more enlarged image at *C'D'* This is what we see if we peer through the eyepiece of the microscope, or what we can photograph if we care to put a film there

The electron microscope shown in the lower part of the same figure is arranged and behaves quite similarly It has illumination, three lenses, and two magnified images in cascade But, instead of light for illumination, it uses streams of electrons from the hot filament or cathode at *F*, and in place of glass lenses, three magnetic coils, by curving the electron paths, do the focusing A more detailed discussion of the instrument will be found later in the article

The analogy between the two microscopes follows the close analogy between light and electricity Visible light, we know, is a wave motion, one of a large family of electro-magnetic vibrations ranging from radio waves to the gamma rays from radioactive materials Figure 2 shows where visible light ranks in this family From the broadcast and short-wave radio bands, down through the infra-red or heat rays, from the red to the violet of our sunlight spectrum, down through the ultra-violet and the X-rays, the wavelength steadily decreases, when we come to gamma rays, we have waves less than a billionth of a centimeter long For convenience, these short wavelengths are measured in angstrom units, an angstrom being a hundred-millionth of a centimeter, or 1/250,000,000 of an inch The visible spectrum ranges approximately from 3900 to 7600 angstroms

WE usually think of an electric current as a stream of electrified particles rather than as a train of vibrations or waves. The electrons flowing in our telephone and lighting circuits we picture as tiny bundles of negative charge Yet the curious thing about them is that under certain circumstances they behave as if they were waves instead of particles In 1924, De Broglie showed that, in theory at least, a moving electron should have a definite wavelength associated with it, and his theory was proved true by experiment some three years later It was shown that electrons, like light, can be reflected or refracted at surfaces, and are subject to familiar interference and diffraction phenomena in which different electron streams add or subtract to form patterns of light and shade (Parenthetically, just as electrons act sometimes like waves, light waves on occasion behave like particles—a beautiful if somewhat confusing example of the harmony and inter-relationships of nature)

The De Broglie wavelength of a moving electron depends only upon its velocity, decreasing as the speed increases A "one-volt" electron—that is, an electron accelerated by a potential difference of one volt—travels at nearly 370 miles per second, and has a wavelength of about 12 angstroms A "million-volt electron," whizzing along at more than 175,000 miles per second, has a wavelength of about a hundredth of an angstrom How this range compares with that of light is shown in Figure 2

This comparison leads to the essential advantage of the electron microscope over the optical variety The ability of any kind of microscope to show clearly minute objects is sharply limited by the wavelength of the illumination it uses. It has been found in practice that this limit is approximately half the value of that wavelength In other words, you can't distinguish objects or details of objects the dimensions of which are less than half of the particular wavelength

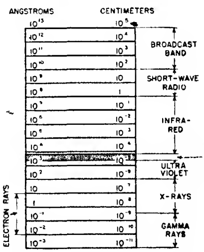


Figure 2: **Comparison of wavelengths of the family of electromagnetic waves and of electron rays**

you choose for illumination Obviously, then, the shorter the wavelength, the smaller the details you can observe

The reason for this is to be found in the phenomenon of diffraction Without going into a full explanation, which belongs in a book on optics*, suffice it to say that diffraction is a special case of interference of waves, and is caused by wave trains bending around corners or the edges of opaque objects Although the phenomenon is universal, we don't ordinarily notice it, for the effects are negligible when the object is large and the wavelength small But in microscope work, where specimens and wavelengths are the same order of magnitude, diffraction rears an ugly head There its effect is one of diffusion and blurring A sharp line in the specimen appears in the image as a broad one, flanked on either side by bands of dark and light A point reproduces in the image as a disk surrounded by dark and light concentric circles These are known as "diffraction patterns"

When you see a circular diffraction pattern in a microscope, you know a particle is present, but different sized particles may have identical patterns and you can deduce nothing about the actual magnitude and shape of the particles Or if two particles in the specimen are less than a half wavelength apart, their diffraction patterns overlap in the image and you cannot distinguish them as two separate points The size of the diffraction pattern does, however, decrease as the wavelength decreases, so it happens that, with short-wave illumination, there is less overlapping of patterns and therefore greater clarity in the image.

THE resolving power of any microscope is the shortest distance two points of a specimen can actually be separated and still appear as two distinct points in the image We have already said that this shortest distance cannot be less than the half wavelength of illumination Thus, with visible light of 4000 angstroms, you cannot get a clear, detailed image of anything much smaller than 2000 angstroms or .00002 centimeters (1/125,000 inch) in diameter With ultra-violet light you may get down as far as 1000 angstroms But now, with high speed, short-wave electrons, it has become possible to observe objects and details of objects smaller than 100 angstroms in diameter — that is, about 1/2,500,000 of an inch

A good example of the electron microscope's power is Figure 3, a photograph of the carbon grains in ordinary lampblack The individual grains are completely invisible in the most high-powered light microscope or even in an ultra-violet microscope. At best, these microscopes show the patch of lampblack

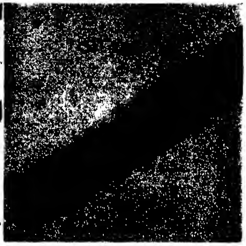


Figure 3, above Carbon grains of lampblack used in making printers' ink, magnified 100,000 diameters One of the best electron microscope photomicrographs ever made. *Figure 4, upper right* A diphtheroid bacillus. *Figure 5, right* Edge of a new razor blade, magnified 24,000 diameters All three figures were made at the University of Toronto

only as an irregular, solid, black blob But illuminate the patch with short wave electrons, and it resolves itself into a myriad of particles, some of them as small as 30 angstroms in diameter—about 1/8,000,000 of an inch! This photograph was made with the new University of Toronto super microscope by James Hillier, one of its designers The total magnification is 100,000 This, however, was reached in several stages, and here a word about magnifications

In order to be distinguishable on the photographic plate, the smallest details of the final image must be several times larger than the chemical grains that make up the film These are about 001 centimeter in diameter If the smallest detail of Figure 3 is 30 angstroms (0000003 cm) it must therefore be magnified some 10,000 times (up to 003 cm) if it is to appear on the film at all

But, in order to be visible to the unaided eye, objects must be at least as large as 02 cm—about 1/125 of an inch Therefore, the 003 cm detail of the microscope photograph must be enlarged up to 02 cm — a magnification of 6 7 times This is done by enlarging the microscope picture by ordinary darkroom methods

The total *useful* magnification is then 10,000 x 6 7, or 67,000, this *represents the total enlargement necessary to make the smallest detail visible to the unaided eye.* Further magnification only makes the picture a more convenient size for study. In some cases it is possible to accomplish the whole useful magnification with the electron microscope, but for technical reasons it is easier to keep its magnifying power under 20,000 and supplement it with optical enlargement

Figure 4 is a diphtheroid bacillus, also photographed by Hillier with the Toronto instrument The bacillus, magnified 35 000 times is about to divide in reproduction, as shown by the slight constriction of its waistline Such a photograph is again utterly beyond the scope of even the best optical microscopes An enormous number of other organic and inorganic minutiae—bacteria viruses, crystal structures, colloidal particles and the like—fall within a size range of from 1000 down to 10 angstroms, or 1/250,000 inch down to 1/25,000,000 inch, and it is in this range that the electron microscope has already proved itself so valuable

IT may well be asked why X-rays or gamma rays, with wavelengths as small or smaller than electrons', could not be used for the same purpose The answer is that no one has ever been able to devise a lens that would focus them Though they belong to the same family of electromagnetic vibrations as light, they are too short-wave to be refracted appreciably by glass, as is light. (It is true that X-rays are very useful in examining the minute intricacies of crystal structure, but the method is entirely different from microscope technique)

The electron microscope is less than a decade old, for its development, which has recently reached practical fruition, began only a few years after the proof in 1927 that electrons have wave properties. The first steps were experiments showing that an electron beam can be

* For example, Valasek's "Elements of Optics" —Ed

focused by a magnetic or electrostatic field, providing the field is symmetric around the axis of the beam. The curving of electron paths in such fields is analogous to the bending or refraction of light rays as they pass through glass, and the field enclosed by a charged hollow cylinder or a solenoidal magnetic coil is thus analogous to a glass lens

The first electron microscope having

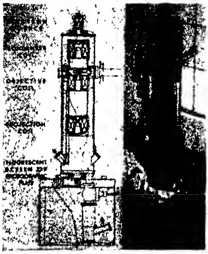


Figure 6: The electron microscope at the RCA laboratories Electrons from top are converged by condenser coil, traverse specimen (introduced through an air lock) above objective coil. This coil magnifies image to 100 diameters Projection coil re-magnifies this image 250 diameters. The image is observed through two diagonal side-windows

magnetic fields as lenses was begun in Germany in 1931 by Knoll and Ruska Not until 1934 was it perfected enough by Ruska to show a definite superiority over optical microscopes Since that time various physicists have been toiling to remove still more of the kinks and further improve the design and performance of the instrument The most notable achievements to date are the three magnetic super-microscopes completed since the spring of 1939—one in Canada, one in Germany, and the latest in the United States

Figures 3, 4, and 5 were taken by the Canadian instrument and give hints of the new world into which the electron microscope affords view Figure 3, showing a resolving power better than 30 angstroms and a useful magnification of 67,000 diameters, is one of the best electron microscope photograph so far published Designed by Hillier and Prebus under the direction of Prof E F Burton of the University of Toronto, the Canadian instrument uses lenses of a radically new design

Last fall the pioneering Ruska and his co-worker, von Borries, developed for a German research institute a microscope with a resolving limit of 50 angstroms, magnifying up to 56,000 times Little word has been heard of its progress since then, but it is capable of excellent work.

The third and latest super-microscope has just been completed in the Camden laboratories of RCA, an important American center for studies in electron optics (a field which applies to radio and television as well as microscopes) Intended largely for commercial use, the instrument has been developed under the direction of Dr V K. Zworykin Its designer is Dr L Marton, another pioneer in electron microscopy, and the first to apply it to the study of biological specimens This instrument, although it does not differ from the others in its fundamental principles incorporates a number of new features of design and construction The limit of resolution which can be obtained is at least 50 angstroms

LOOKING back now at the lower part of Figure 1, let us trace the path of the electron beam through the electron microscope more in detail The whole instrument is enclosed with air-tight fittings and pumped free of any gas which might interfere with the passage of electrons In this high vacuum, the cathode, *F*, and anode behave something like a radio or thermionic tube The cathode—a metal filament or coated metal plate—is the source of the beam, emitting electrons as it is heated by an electric current. The anode is a metal plate kept at a high positive potential—perhaps 50,000 volts—which attracts the electrons and accelerates them to a high speed A tiny hole in the anode lets through a narrow beam of these 50,000-volt electrons (wavelength · 055 angstroms) The magnetic lens shown in cross section at L_1 concentrates the spreading beam into parallel rays that fall on the object at *AB*

The object—suppose it is the diphtheroid bacillus of Figure 4—has to be supported somehow, and its support must be so thin that it doesn't interfere with the passage of the electron beam A collodion film 150 angstroms thick (about three five-millionths of an inch) is a common choice corresponding in function with the glass slides used for ordinary microscopic specimens.

As the beam falls on the specimen at *AB* in the lower part of Figure 1, some of the electrons are absorbed and some are scattered, in proportion to the thickness or density or other properties of the various parts. The transmitted electrons correspond to light of varying intensity reflected into your camera by an object you are photographing, these are what produce the areas of light and shade on the film, and constitute a negative of the final picture

The transmitted electrons pass on through the magnetic lens L_2 to form a somewhat magnified image of the bacillus at *A'B'* In the early stages of the microscope, this was the final image and the one that was photographed. But, as the instrument was improved, another magnetic lens (L_3) was added to give still further magnification

The final image at *C'D'* is usually photographed, but under certain circumstances can be seen visually. If a fluorescent screen is placed at *C'D'* the electrons impinging on it cause it to glow in the pattern of the image. This can be observed through a viewing window cut in the wall of the microscope. By watching this picture, and moving the specimen, it is possible to search for interesting organisms or structures. If one of sufficient interest is found, it may be photographically recorded for closer scrutiny by merely lifting the fluorescent screen out of the path of the electrons, so as to allow them to fall directly on the photographic plate However, since 02 cm is the limiting size of objects seen visually, and if the fluorescent screen is used, the microscope must accomplish the whole useful magnification without any supplementary optical enlargement to clarify details

It is quite possible to use the cathode itself as a specimen, and let it take a picture of itself with the electrons it emits as it is heated in a vacuum In this case, no object is put between the cathode and the photographic plate. A similar optical example would be to photograph the hot filament of an electric bulb with an ordinary microscope, using the light of the bulb for illumination Very valuable studies of the surface structure of various cathode metals

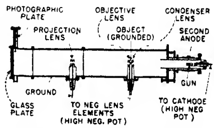
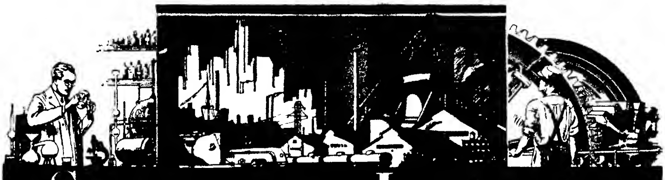


Figure 7. An electron microscope which uses electrostatic fields instead of magnetism to bend its rays

have already been carried out, with series of electron microscope pictures showing how the structure changes as the cathode is heated to different temperatures.

It has been stated that either magnetic or electrostatic fields may be used as lenses Thus far we have chiefly discussed the magnetic model, which is at present the type most used for high magnification studies of specimens which do not themselves emit electrons. The electrostatic microscope has not in the past received as much attention in spite of the fact that it was first developed (by Brüche and Johannson) about the same time as Knoll and Ruska began working

(*Please turn to page* 32)



SCIENCE AND INDUSTRY

A MONTHLY DIGEST

Conducted by F. D. McHUGH

Contributing Editor
ALEXANDER KLEMIN
In charge, Daniel Guggenheim School of Aeronautics, New York University

COAL AND KILOWATTS

WHILE three to five pounds of coal were required to generate one kilowatt hour of electric power 20 years ago, points out M. W. Smith, vice president of the Westinghouse Electric & Manufacturing Company, improvements in generators, turbines, boilers, condensers, and stokers have increased efficiency until today the coal consumption of some of the new high-pressure, high temperature steam turbine generating stations is less than one pound per kilowatt hour "Other means of power generation," he added, "are now being considered which show the theoretical possibility of cutting in half even this low value of fuel consumption."

CARBOLOY EXTRUSION PROCESS

CARBOLOY cemented carbide now can be produced in the form of tubing, spirals, and round or shaped bars by means

Carboloy in many shapes

of an extrusion process, it was announced recently by Carboloy Company, Inc. Available in lengths up to 20 inches and within a diameter range of from .015 to 3/8 of an inch outside diameter, these rods, spirals, and tubes are considered a distinct innovation compared with previous practice Formerly such parts were available only within an extremely limited size range and it was necessary to perform a large part of the shaping operation manually. With the new process now employed, the Carboloy parts are formed directly into the shapes desired, eliminating most of the customary hand forming operations

To those familiar with the limitations ordinarily encountered in working cemented carbides, the Carboloy tubing now produced is of especial interest This can be made as small as 060" outside diameter by 030" inside diameter, leaving a wall thickness of 015"

The limitations have been overcome by the development of a new process of extrusion By this process the dry powder is mixed with a plasticising medium and can then be formed by extrusion or molding into almost any shape

Particularly interesting is a supplementary process, by means of which Carboloy rods, and so on, can be bent to various shapes. The 5 inch diameter ring illustrated was produced through this process. It consists of a round rod curved to form a ring, with the ends joined together

GAGE MEASURES LACQUER AND THIN PAPER

AN electric thickness gage, designed by General Electric engineers, has a full-scale range from 0 to 0 0007 for measuring non-magnetic coatings on steel and can measure coatings of lacquer only 0 0001 of an inch thick, such as that used in the canning industry on the thin sheet-iron of the cans

Thin paper, as used in the manufacture of capacitors, and even thin electroplatings on steel can also be measured. The gage will measure a deposit of 0 0001 of an inch thickness on ordinary commercial tin-plated flat sheet stock to a plus or minus 25 percent accuracy, and heavier coatings are measured to a much greater degree of accuracy To obtain the correct gage response, the material to be measured must be backed with magnetic material to serve as the magnetic-flux return for the gage.

PREVENTS SHOCK IN SURGICAL OPERATIONS

SAFER surgical operations and speedier recovery from them, especially for debilitated patients, seem promised by a new treatment for preventing dangerous shock during and after operations The treatment, using a synthetic adrenal gland hormone, was developed by Dr David Perla, of Montefiore Hospital Striking benefits in 14 cases at this hospital are reported by Dr Perla, who said that the treatment will shortly be adopted in two other New York City hospitals

The patients treated at Montefiore were what would be considered poor surgical risks because serious chronic illnesses such as cancer and tuberculosis had weakened them so that they would have little strength to withstand an operation. With the new treatment, patients are prepared for opera-

Non-magnetic coatings on steel are accurately measured with this set-up

tion by being given quantities of salt solution and carefully prepared doses of desoxycorticosterone acetate This chemical is the synthetic vital hormone of the adrenal glands Earlier studies have shown that these glands play a significant rôle in the body's fight against intoxications, poisons, shock, and infections The adrenal cortical hormone, Dr Perla explained, influences the transfer of water from tissues to cells and the level of salt in tissues and cells Disturbance of this glandular balance, which frequently occurs in an exhausting operation, leads to collapse —*Science Service*

SCOOP

TANKS between the rails from which railroad locomotives scoop up water without coming to a stop were first used in 1872

Fade-Proof Interior Finish

THE Wood Conversion Company has just announced Kolor Fast Nu-Wood as an improvement in insulating interior finish This new product is the first of its type for which fade proof qualities are claimed These claims are based on severe tests by nationally recognized laboratories, which tests have established the light fast qualities

Nu Wood Kolor Fast is available in tile and plank in variegated and tan colors Nu Wood Kolor-Fast Board is available in tan The colors are richer and clearer than before The over-all colors are slightly lighter, giving the material a higher light reflection value in keeping with the modern tendency in interior decoration

Heretofore, all insulating interior finish board materials have been subject to oxidization which resulted, over a period of years, in darkening of the material

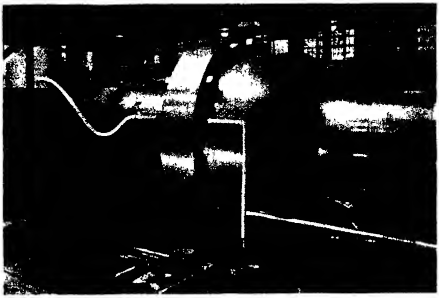
Rod-Lights for Industry

SEEMINGLY there is no end to the light transmitting uses of Lucite Sometime ago we discussed in these pages new flash lights for medical examinations which used Lucite rods to carry the light into such close spaces as a patient's throat An accompanying illustration shows a number of new forms of Lucite flash lights developed by Dr D L Weiss for wide use in industry and repair work

Dr Weiss's development makes use of a small fountain-pen-size flash light, or a handle of the same shape connected to a small transformer which, in turn, is plugged into an alternating current socket

Various types of this new unit, called Ang-Lite, are being used in many manufacturing operations to examine assembly of complicated apparatus The light travels down the Lucite rod and is thrown off in a bright spot at the tip Instrument makers and repair men can examine with these units parts of their equipment difficult to get at One type, having a rubber-mounted magnifying glass, throws a light directly on textiles, printing, or other surfaces to be examined Other forms of these rods, fluted spirally in order to throw a glow of light throughout their length are used for mixing operations or to observe chemicals in a mixture In the photographic darkroom Lucite rods of proper color may be used not only as working lights but also as a means of stirring the photographic baths and throwing a glow of light directly on negatives and prints that are being developed

Light-conducting rods of various shapes used in flashlight (center)



Alcohol, cooled by dry-ice to 40 degrees below zero, Fahrenheit, is used for shrinking the bolts in this water-power coupling assembly so that they may easily be removed from their carefully fitted holes The assembly shown set up in the shop of Allis-Chalmers Manufacturing Company, is a huge coupling for connecting the water wheel and generator shafts of one of the three 30,000 kva generator units for Chickamauga Dam The tank containing the dry-ice and alcohol may be seen at the left In assembling such couplings, the bolts are first shrunk by placing them in a box containing dry ice

New World's Record Pressures

NEW world's record high pressures, as much as 3,500,000 pounds per square inch, have been achieved by Dr P W Bridgman in Harvard's Physics Laboratories through use of nests of high pressure vessels in which inside apparatus receives outside support at critical parts

A piece of tool alloy, Carboloy, composed of tungsten carbide and cobalt, was subjected to a compressive stress of between 2,800,000 and 3,500,000 pounds per square inch, without fracture Carboloy's crushing strength under normal conditions is not more than 1,000,000 pounds per square inch

Dr. Bridgman, in reporting his results to the *Physical Review*, also made known that under such extreme pressures, carbon in the form of a thin plate of crystal graphite is not converted to diamond at room temperature There had been hope that pressure alone might cause the formation of diamond out of this form of carbon "It is probable that no pressure, however high, will accomplish the conversion at room temperature," Dr Bridgman now concludes

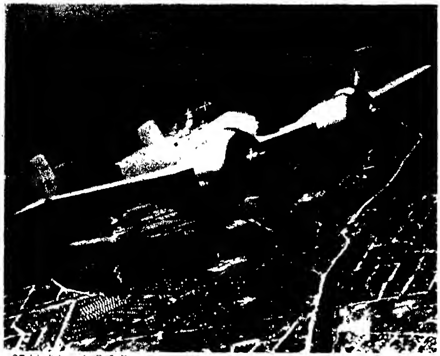
A striking effect of the extreme high pressures on Carboloy was that, although under normal conditions it is highly brittle and breaks with practically no plastic deformation, under the confining pressures used by Dr Bridgman the piston of this tough material was plastically and permanently shortened by 5 5 percent with no perceptible cracks —*Science Service*

Paint-Receptive Aluminum

UNTREATED surfaces of aluminum and its alloys possess no natural affinity for paint, lacquer, or enamel coatings Ordinarily such finishes will not adhere permanently Use of aluminum has, therefore, been limited to those products on which no coating is desired

In the Metal Finishing Laboratories of the Pyrene Manufacturing Company a simple process has been developed for the treatment of aluminum so that it will take these finishes This process, which has proved so satisfactory under ordinary plant production conditions and whose flexibility is demonstrated by its successful use on a wide variety of parts such as microphones, transmitters, instrument panels, switch parts, has been named the Pylumin process

Pylumin powder is a mixture of several chemicals which, when dissolved in boiling water, forms a solution that reacts quickly upon aluminum, converting the surface into a non-metallic film of complex basic oxides, thereby forming a coating which is highly resistant to corrosion and also serves as a



Official photograph U S Navy

Grumman *Sky Rocket*, designed for operation from naval aircraft carriers

base for paint, lacquer, or enamel finishes Pyluminized metal is of a uniform gray to black color, depending on the composition of the metal treated, and is velvety in texture

The Pyluminizing operation involves only the simple immersion of parts in a heated solution in a steel tank The processing action is fast, requiring only three to ten minutes immersion in the boiling Pylumin solution

First Tests of The Grumman "Sky Rocket"

THE construction of the Grumman *Sky Rocket*—the XF5F-1, to call it by its Navy designation—was undertaken by the Navy Department well before the war broke out in Europe, when it became apparent that high performance fighters with long range and endurance would be required to accompany heavy bombing airplanes on long flights The European war confirmed the Navy's viewpoint. Long range bombers operate best if supported by fighters of equal endurance.

The XF5F-1 is a carrier-fighter and has the control, maneuverability, and relatively small dimensions necessary for operation from the deck of an aircraft carrier. Although it is equipped with two Wright engines of 1200 horsepower each, it has a gross weight of only 9000 pounds, and a span of only 40 feet The square wing tips and the square tail surfaces are intended to increase production possibilities without detracting from aerodynamic efficiency

Although the new ship has been released for sale to the French Air Commission, definite information regarding performance is lacking. Take-off occurs in about seven seconds. In one of the tests the *Sky Rocket* flew about 100 yards in advance of a standard pursuit and suddenly began a steep climb which the older craft was unable to duplicate. Climb was said to be 4500 feet a minute without full power. Top speed is reported to be 450 miles per hour, a figure which is at least plausible It is noteworthy that the two Curtiss controllable pitch propellers of 10 feet diameter rotate in opposite directions We have often in these columns pointed out the desirability of twin engined propellers turning in opposite directions Both control and stability, and the aerodynamic efficiency, are improved thereby. Altogether, there is no doubt that the new machine will be a worthy and gratifying addition to the air equipment of the Allies —*A K*

A Plea For Many Small Landing Fields

IN a recent speech, Robert Hinckley, Chairman of the Civil Aeronautics Authority, deplored the short length of time that the private owner keeps his ship before reselling it Four out of five of the men who buy private planes sell them within a period of two and one half years, and do not buy other planes One third of such owners actually dispose of their craft in one year without purchasing another This is a deplorable situation and in sharp contrast to the case of the automobile, where a man who has once owned a car will mortgage his home if there is no other way of buying a new one Mr Hinckley thought that the situation was due to a combination of several factors, possibly too many log books and inspections, possibly too few small air ports and landing fields

The lack of small landing fields is indeed a very important reason At least so thinks Jerome Lederer, well-known Chief Engineer of Aero Insurance Underwriters We cannot resist quoting part of what Mr Lederer had to say at the North Central Regional Planning Conference. "At present the private pilot may be likened to the owner of a little sailboat in a stormy area with very few harbors to run to for safety Only the more venturesome will dare to risk a sail along the forbidding shore . . If only there were small inlets along the shore, not necessarily large harbors, these less venturesome folks would try coastwise sailing too, and have more fun Likewise, the private pilot does not want large airports Small landing fields located at frequent intervals in every direction would furnish much greater incentive than now exists to make cross country flights These fields would furnish men much more chance of getting down safely if bad weather were encountered, besides giving the private pilot greater opportunities to use his airplane"

La Guardia Airport has been criticized for charging large landing fees We believe that the authorities of this Airport are perfectly right in so doing Promiscuous use of the transcontinental airports would make air traffic control difficult and increase hazards What is needed is a nation-wide movement for a multiplicity of small fields, and every reader who can in some manner encourage the construction of such fields will be a welcome ally to the cause of private flying.—*A K*

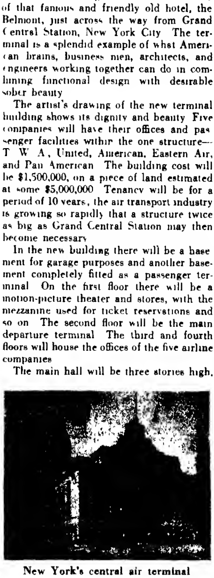
The First Central Air Terminal

IN a personal interview with Floyd Del Brown, architect and President of the Bethlehem Engineering Corporation, we obtained details of the new central air terminal which is being constructed on the site of that famous and friendly old hotel, the Belmont, just across the way from Grand Central Station, New York City The terminal is a splendid example of what American brains, business men, architects, and engineers working together can do in combining functional design with desirable sober beauty

The artist's drawing of the new terminal building shows its dignity and beauty Five companies will have their offices and passenger facilities within the one structure—T W A, United, American, Eastern Air, and Pan American The building cost will be \$1,500,000, on a piece of land estimated at some \$5,000,000 Tenancy will be for a period of 10 years, the air transport industry is growing so rapidly that a structure twice as big as Grand Central Station may then become necessary

In the new building there will be a basement for garage purposes and another basement completely fitted as a passenger terminal On the first floor there will be a motion-picture theater and stores, with the mezzanine used for ticket reservations and so on The second floor will be the main departure terminal The third and fourth floors will house the offices of the five airline companies

The main hall will be three stories high,



New York's central air terminal

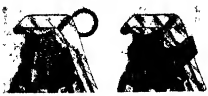
160 feet in length, and 100 feet in width There will be six platforms side by side, with hydraulic platforms for raising the passenger buses Passenger coaches will discharge passengers at the incoming terminal, proceed to the garage for minor attention, and will then roll on to the hydraulic lifts and be raised to the departure platforms A minimum amount of attention will be required as doors and elevators will all operate automatically The whole will constitute a remarkable system of "uniflow," as the engineers call it in steam-engine design Not only will there be a minimum loss of time and a minimum expenditure in handling coaches, but there will be avoided the sorry spectacle of airline coaches parked along the street near some small and insufficiently equipped ticket office as at present

The building, which runs from 42nd to 41st Streets, will have its bus exit on 41st Street With but three blocks of city traffic, the coaches will then be at the entrance to the Third Avenue Long Island Tunnel Then Queens Boulevard and La Guardia Airport will be within easy reach It is estimated that no more than 20 minutes will be required for the entire trip —*A K*

Hand Grenade Safety

THE layman will not think of humanitarianism in connection with a hand grenade Yet that is the essence of a new locking device for hand grenades developed by Norwalk Lock Company, Division of Segal Lock & Hardware Company, Inc

Often a soldier has occasion to pull the pin from his hand grenade many seconds



or perhaps minutes before he may need it — in a charge against enemy trenches, for example Should he then find that the trench already has been mopped up, he must dispose of the hand grenade somehow, for the minute he releases his grip on the metal handle, the firing pin snaps over and in five seconds the grenade explodes Only too often have soldiers been blown to bits by their own hand grenades

The new development consists of a metal collar around the neck of the grenade A projecting arm is so bent that a slight turn of the collar with the thumb of the hand holding the grenade pushes this arm around to hold the detonating cap holder in cocked position A number of fins on the collar provide a positive grip for the thumb

Twins More Likely to Older Parents

IF you are an expectant father, your chances for having twins instead of one son or daughter are greater with each year of your age it is revealed by a statistical study conducted by the National Institute of Health and reported to *Human Biology* by Drs J Yerushalmy and S E Sheerar

Older mothers are more likely to give birth to twins than are younger women. And twin births occur with much greater frequency in families already large than they do as first or second births.

But the fact that older fathers are more likely to have twins cannot be explained by the fact that older women are more likely to have older husbands. When only the births to young mothers are considered, there is still a steady increase in the proportion of twin births to total deliveries with advancing age in the father.

The influence of age in father and mother and order of birth, although showing up clearly when all twin births are considered, seems to apply principally to the births of non identical twins, those resulting from a double ovulation rather than the dividing of a single egg cell — *Science Service.*

PULLMANS

AN average of approximately 32,000 persons sleep every night in Pullman berths on American railroad trains.

The Pittsburgh of Old Palestine

IN our January issue, Director Nelson Glueck, of the American School of Oriental Research, Jerusalem, described excavations at an arm of the Red Sea, which had brought to light a buried city with a smelter in which King Solomon refined his copper A second season of excavations at the same site has revealed that there was a much more extensive system of similar refineries than had previously been expected. Indeed, practically the entire town of Ezion-geber proves to have been a phenomenal factory site, of a nature unparalleled in the history of the ancient Near East, according to the same archeologist writing in *American Journal of Archeology*

Flower Watering Gage

A NEW and inexpensive device for determining the amount of moisture required by potted plants and by seedlings in seed flats has been introduced by Fabaco Company, Inc Known as the "Soil Rite" watering gage, it is placed in pots or flats deeply enough so that its point is in close proximity to the roots, thus registering the degree of dryness or moisture at that depth on a scale Acting as the "voice" of the plants, this gage takes the guesswork out of watering, a problem that has been the death of many a plant. A

Soil-moisture indicator

chart lists some of the more popular desert plants, those requiring moist soil, and those that do well only when the soil is wet, so that one knows the moisture requirements of the more common plants and will not under-water or over water them —*C F. Greeves-Carpenter*

New Ships for Merchant Marine

IN May there was launched at the Newport News Dry Dock and Shipbuilding Company, the steamship *President Jackson*, first of a new series of ships being constructed for American President Lines Round-World Service Other Presidents to be honored by this series will be Adams, Monroe, Jackson, Van Buren, Polk, Hayes, and Garfield

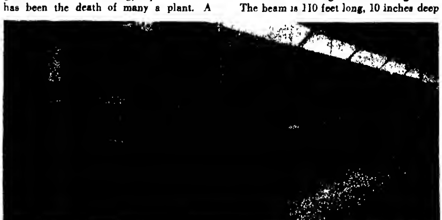
These new ships will be of 9300 tons gross, 492 feet long, 69 5 feet beam, and have a speed of 16 5 knots

Largest Wooden Beam

AN accompanying illustration shows the largest laminated wooden beam ever built This beam owes its existence to Laux Self-Bonding Glue with which it was fabricated in the plant of the Speedwall Company in Seattle

Regular two by ten's of a maximum length of 20 feet made up the laminations in this beam which contains a total of 3780 board feet of lumber Of the self-bonding casein glue, 118 pounds were necessary, while only enough nails were required to insure adhesion while the glue was setting.

The beam is 110 feet long, 10 inches deep



There are 3780 board feet of lumber in this 8791-pound beam

at the ends, and 52 inches at the center. Weighing 8791 pounds, it is capable of supporting a roof load of 65 pounds per square foot of roof. In our illustration, the beam is being tested under a load of 650 pounds per lineal foot.

FIREPROOF

THROW all the cigarette butts and lighted matches you want to on a new awning and it never burns. It is woven of fiber glass yarn. Besides being fire-proof, it is rot-proof and will not mildew.

Mending Cement

A LATEX cement, which is being sold under the name Liquid Thread, mends fabrics, paper, leather, or leatherette, and adheres to such non-porous materials as glass. Used on fabrics, it provides a heat-proof and water proof mend, and is said to be unaffected by washing and ironing. Liquid Thread is made by Paste Elastic Manufacturing Corporation.

It may be used for joining or binding rugs and, when applied as a coating, it imparts anti skid qualities to rugs, telephone bases, and similar objects. It also finds use as a general adhesive in the office, home, and school.

A Problem for the Resourceful Inventor

THE skin prevents the escape of body fluids. Its thickness varies in different parts of the body. It is freely movable in some places and tight in others, and the creases mark where it is bound down. It has minute ridges which improve the grip on the palm and sole and marvelously afford the only permanent and absolute means of personal identification with finger prints.

With all our modern ingenuity in creating machinery and fabrics, we cannot create a tough yet highly elastic one that will withstand heat and cold, wet and drought, microbes, and the wear and tear through the years and yet make its own repairs and even assemble in summer a protective pigment against the sun's rays. The skin is a regulator of body temperature, an excretory organ, and the largest and most versatile of our sense organs. The skin helps to form the ear drum, it covers the eye ball, from it originate the teeth, and in it are millions of tiny glands. Finally, when sunlight or ultra-violet is shed on it, the ergosterol in the skin produces vitamin D.—*Journal of the American Medical Association.*

Roses Treated with Gas from Apples

ARTIFICIAL autumn can be brought to rose bushes, causing them to shed their leaves in a few days, by locking them up in the same room with apples, it has been discovered at Oregon State College by J. A. Milbrath, Elmer Hansen, and Prof. Henry Hartman.

Ordinarily such defoliation would be undesirable, but when large numbers of field-grown rose bushes are being prepared for shipment to market it is necessary to rid them of their leaves, to cut down water loss

through evaporation. Hand plucking is tedious and expensive — a thorny job at best

By putting the bushes in a tightly closed, moderately heated room, with one bushel of apples to every 300 or 400 cubic feet of space, they can be caused to shed their leaves in about four days. The apples produce this effect because they give off small quantities of ethylene, which is also a common constituent of natural gas.—*Science Service*

Metal Nibbler

PORTABILITY, speed, and power are characteristics of a new portable nibbler with which all types of sheet metal products may be cut into odd shapes for fitting. This new Thor nibbler cuts panels,

sheets, or tubes up to 18 gage in steel and up to 15 gage in aluminum It follows line or contour accurately, cuts plain or corrugated stock and will cut tubes as small as 1½ inches in diameter. Operated with one hand, it will not distort the sheet and makes inside cuts easily

This nibbler is equipped with a universal motor in standard voltages of 110 or 220 volts Full load input is 200 watts

Window Cleaning Compound

MEETING the growing demand for a solvent suitable for use in the manufacture of window cleaning compounds, U S Industrial Chemicals, Inc, has developed a new concentrated solvent blend that can be diluted with water to make a finished liquid cleaner.

In placing this solvent on the market, U S I has made it possible for manufacturers of cleaners to offer a highly effective product

All that is needed to manufacture the finished compound is to dilute the new solvent with water. The final compound may contain from 15 to 50 percent by volume of the solvent, as desired Even the 15 percent mixture is safe for storage in cold weather

The 50 percent dilution, it should be noted, will affect paint, varnish, and lacquer, and will soften celluloid (such as eye-glass frames). The 15 percent compound, however, may be used safely on such surfaces and is an excellent polish for eye glasses.

Naval Construction

LAUNCHING of the battleships *North Carolina* and *Washington*, early in June of this year, marked the first launching of a battleship by the United States since the early twenties Both of these ships should be ready for shakedown trials within another year. The keels of three other battleships—*South Dakota, Indiana,* and *Massa-*

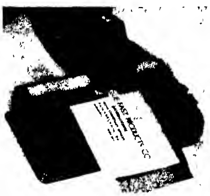
chusetts—were laid in 1939, and the keel of a fourth, the *Alabama*, was laid in February 1940 Two others, the *Iowa* and *New Jersey*, have been let on contract to the New York Navy Yard and the Philadelphia Navy Yard, respectively, and their keels will probably be laid shortly, now that the *North Carolina* and *Washington* are off the ways

As of March 1, 1940, progress of other naval construction in navy yards and private yards was as follows

Two aircraft carriers were under construction, one of which, the *Wasp*, has since been placed in service Contracts have been let for six light cruisers, for one of which the keel was to be laid late in March Fourteen submarines have been ordered, of which two were launched, two were scheduled for launching in March, and the keels had not been laid for three Keels had been laid for all except two of 27 destroyers Nine of these have been launched and two others were scheduled for launching early in March Keels have been laid on most of the remaining ships comprising tenders, mine sweepers, a repair ship, a mine layer, submarine chasers, and a large number of motor torpedo boats Of these, two DD tenders, a fleet tug, a submarine chaser, and two motor torpedo boats had been launched

Label Gluing Machine

SHIPPING rooms of factories, stores and business offices are faced with one slow but always messy job—that of pasting shipping labels on packages Pre gummed labels are not only difficult to handle but are expensive The Glue Fast Equipment Company, Inc, has worked out a simple gluing machine which operates like many well-known moisteners but which makes



unnecessary the pre gumming of labels. This machine covers the surface of the label with a thin film of glue

The operator of this machine uses only one hand to slide the label under the guide bar Pulled across the roller, the label is gummed so that it can immediately be spread on the package and there is no necessity for wiping off excess glue—there is no excess.

Leather Electro-Plating

THE fad of electro-plating babies' shoes to preserve them, and the manufacture of certain kinds of metallic decorative leather, make the following formula of interest to many of our readers

All leather to be plated must first be carefully cleaned to remove oils, greases, and the like and then dried and coated with

orange shellac to make it waterproof. An additional coat of shellac or an air-drying varnish is then put on the surface and sprayed or brushed with copper or bronze powder while still tacky in order to make it conduct electricity. Once this has fully dried, the leather is electro-plated in the usual manner in an acid copper solution. Following the copper plating the leather is rinsed, scraped, brushed, or buffed and is then oxidized or plated with the final coating of metal.

This process can be used on wood, plaster, flowers, and other such objects, according to the magazine *Metal Industry*.

New Magnet for Medical Use

A NEW magnet for the removal of metal fragments from the eyes and surface wounds has been devised by the General Electric Research Laboratory in Schenectady. Though not designed to replace the

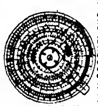
powerful electromagnets in this field, the new instrument is more powerful and more easily handled than earlier permanent magnets used for the purpose. Sintered alnico, an alloy of aluminum, nickel, cobalt, iron, and copper, is used with a high permeability insert of nickel-iron to collect the flux at the point. The magnet is light in weight.

RUBBER

THE 1940 rubber requirements of one popular make of automobile would make a single monster tire 346 miles in diameter and 80 miles wide.

Airplane Armor Plate

WALTER Winchell in his Sunday-night broadcasts has often made the statement that American fighting planes are as efficient as any made in the world today with the single exception that the pilot has no armor-plate protection. The Jessop Steel Company recently reported that they have just completed shipment on a large number of sets of armor plate to be installed in the cockpits of combat planes. These pieces are so placed as to afford protection to fire from below and from the rear. The armor plate for this order was specially heat-treated to procure maximum ballistic resistance to penetration. Consequently, the



gage is comparatively thin and the weight reduced to a minimum while giving protection against machine-gun bullets and shell splinters.

Universal Angle Vise

A NEW type of universal vise for use in connection with milling, grinding, and drilling operations permits easy production of even complicated compound angles. The vise is adjustable in three planes. Graduated scales are provided in each plane so that

the vise may be set up for a complicated angle operation as easily and quickly as for a simple angle

A special feature of this new vise is its accuracy and ability to handle heavy cuts. The vertical member is built like a cradle, it rocks in a solid base. All steel construction gives added strength and makes the vise light and easily portable It may be moved from one machine to another for successive operations without disturbing the work This vise may also be used as a gage in checking the accuracy of angles which have already been produced

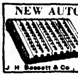
To Protect Rusted Fences

RUSTED fences present a difficult painting problem First of all, it is practically impossible to remove the rust and prepare the surface for ordinary types of paints. Furthermore, the links "chafe" the touching pieces of wire and cause the paint to crack and chip away. A new product, Fence-Bond, made by the Skybryte Company, solves these problems.

Fence-Bond is a factory-mixed, ready-to-use aluminum paint specifically designed for painting rusted fences. The factory mixing is said to result in a more uniform dispersion and a more silvery, lustrous surface that will protect the fence despite rust that may be present before the repainting. Chafing and cracking are prevented because the paint remains plastic enough to take up all movement from expansion and contraction or other causes.

Kidney Extract for Gastric Ulcer

HOPE for stomach ulcer patients appeared in a discovery announced at the recent meeting of the Federation of American Societies for Experimental Biology For these patients there will be the new hormone urogastrone, obtained from kidney excretions. First trials on 10 normal persons showed that this hormone can stop the



formation of acid by the stomach, Drs. A. C. Ivy, E. Wiezcorowski, and J. S. Gray, of Northwestern University Medical School, reported. At present, ulcer patients must take alkaline powders to neutralize the acid in their stomachs so that it will not irritate the ulcers and cause bleeding.

The new hormone will be injected under the skin. Such injections at present cause swelling and reddening. Dr. Ivy and associates hope shortly to overcome this feature by further purification of the hormone, after which it will be ready for use in treating ulcer patients. The hormone treatment, by checking the acid in the stomach, will give the ulcer a chance to heal.—*Science Service.*

AGAR

In dried form a grayish, light, stringy solid, agar is made solely in Japan because the harvesting of the seaweed from which it is made, and the processing, require much hand labor, which is cheap in that country. Should the supply be interrupted, all manner of research institutions would be handicapped, for it is used almost invariably as a culture medium in research involving germs.

Machine Post Office

A COIN-OPERATED post office, called the Mailomat, has been intriguing commuters and others with letters to mail at the last minute—in both of New York's great railway terminals. This machine is, in reality, a self-service post office, for if the letter is dropped in with a coin the machine prepays postage and postmarks the letter. No stamps are necessary and it is not necessary to run the mail collected from this box through the cancelling machine at the post office. The Mailomat is manufactured by Pitney-Bowes Postage Meter Company.

Off with Peanut Skins—Chemically

BEFORE peanuts can be used as a food, the unpalatable reddish-brown skin which closely covers the nut must be removed. This has been a problem in the manufacture of peanut products. Home economists in the Department of Agriculture now have developed a commercially practical way to remove the skins with low weight loss and no splitting, and still have a nut high in quality. The shelled nuts are dipped in a 1 percent hot lye (sodium hydroxide) solution for about eight seconds just long enough to moisten the skins. They are then dipped immediately into a cold, 1 percent solution of hydrochloric acid to reset the dissolved pigment in the skins and thus keep it from staining the nuts. The nuts are then rinsed in cold water and the skins easily removed by hand. The nuts are dried at room temperature before storage.

Peanuts skinned in this way retain their smoothness and gloss and keep much longer than those blanched either with hot air or hot water. The weight loss is low — 3 to 6 percent as compared with around 18 percent for the usual commercial hot-air treatment.

SEEING WITH ELECTRICITY

(Continued from page 22)

on magnetic lenses. The principle of this type of instrument is shown in Figure 7, a diagram of an electrostatic electron microscope now under construction in the Camden laboratories of RCA. Here radially symmetric electrostatic fields between suitably shaped apertures serve as lenses. While the actual construction of the instrument is quite different from that of the microscope described, the operation is quite similar. These electrostatic lenses now appear to be capable of the same high magnification as the magnetic lenses, but the ultimate resolution that can be obtained with them has yet to be determined.

We could hardly leave the subject of the electron microscope without giving at least a sketchy account of some of the difficulties which beset it. Any microscope, optical or otherwise, is allergic to certain "bugs" in the works, some of them inherent in the illumination itself, and most of them leading to distortions and aberrations of the image.

Among these is diffraction, which we have already mentioned, explaining how it limits the resolving power and tends to blur the image. But present-day electron microscopes still have a long way to go before they attain their theoretical resolving limit of half the wavelength of the electron. Even so, the fact that, for a given specimen, diffraction effects decrease with wavelength, gives the electron microscope an advantage over the optical instrument. As large a part of that theoretical advantage as can be exploited practically is being sought for use.

Figure 5 is an electron microscope photograph of the edge of a new razor blade, magnified 24,000 times. The section of blade pictured is .00003 cm (about 1/83,000 inch) across—a distance within the scope of good optical microscopes. But, had the latter been used, diffraction would have blurred the indentations of the edge, and the picture would lack the detail and exquisite clarity of line given by electrons.

With present electron lenses, a number of errors other than diffraction are of great importance, and keep the resolving limit far above its lowest theoretical value. Distortions of the image result if the electric or magnetic field lenses are not perfectly symmetrical or constant, if the accelerating potential varies even by a volt or two; or if the velocity of the electrons is slowed too much by passing through the specimen and its mounting. Once again, each of these electron lens errors has an analogue in optical lenses: spherical aberration, chromatic aberration, astigmatism and so on.

The proper mounting of all types of biological and physical specimens also presents a problem which is at present far from being solved. The men working on it have been successful in mounting a number of types of bacteria, colloidal particles, and other physical specimens, but the extension of the list and the interpretation of the images is more difficult. However, when one considers that, after a century of work, the corresponding problems of light microscopy are far from complete solution, the development of the super-microscope and its associated technique appear almost phenomenal.

TELESCOPTICS

A Monthly Department for the Amateur Telescope Maker

Conducted by ALBERT G. INGALLS

OPTIMUM is the word to characterize the Richest Field Telescope, which affords a optimum broad view of the heavens

"I enclose a photograph (Figure 1) of a 6", short-focus reflecting telescope made for me by two friends, W F Gale in the chair," writes G H Hoskins, of Ewarra, Brewongle, New South Wales, Australia "My interest was aroused by a chapter on 'The Richest-Field Telescope,' in your book, 'Amateur Telescope Making--Advanced'

"The telescope is 30" long over all, focal

Figure 1 RFT made in Australia

length is 24", mirror is 6" diameter, Ramsden eyepiece, magnification 19 diameters, field of view 2°

"It struck me, when suggesting its construction, that the design could be made more comfortable to use, hence a leather covered pad was attached to the base, so that the telescope could sit easily on a rather bony knee—it also helps to take up vibration The eyepiece is just at the right height when one is sitting in a chair A door handle is attached to the tube, to allow safe carrying, but it also gives a remarkably steady hold when observing—the telescope is steadier than a binocular Another part of the apparatus, and a most useful one, is the alt-azimuth mounting shown This is extraordinarily good

"I have used telescopes, up to 18", but in none of them have I seen such comprehensive and beautiful views of the heavens As a comet seeker it would be hard to find its equal and, for ease of use, I know of no other unmounted telescope to approach it All thanks to 'ATMA'"

Thanks mainly to S. L Walkden, father of the RFT.—*Ed.*

ENDLESS and largely futile has been the age-old debate between exponents of the refracting telescope and those of the reflector After years of near ostracism by American amateur telescope makers, the refractor is now in the social swim, thanks largely to J R Haviland's lengthy and detailed treatise in "ATMA" An amateur whom we shall designate as X, because he prefers to be anonymous, has completed a 7½" refractor (Figure 2) and says he enjoyed the job, also likes the telescope

X says he feared to begin the 7½" objective lens as his maiden refractor job but, after a talk with J R Haviland, he felt encouraged to wade in The 8" flat required in testing the objective, good to a quarter wave, was successfully completed in 150 hours Then came the actual objective "It definitely was not difficult," states X. "The edge testing jig and spherometer described by D Everett Taylor, in the February, 1940, Scientific American is the thing However, I found the three-ball jig recommended in 'ATMA' by Haviland was good Using a Starrett gage on the Taylor equipment, it was necessary only to take a little care and use patience to get the crown and flint to radius and the edges within the limit of accuracy of the gage This eliminated the bugbear of centering

"To avoid scratches I ground glass blanks to the same radius as each curve and used these to break in the pitch laps Figuring was rather baffling until I tried Ellison's stunt of putting a heated flannel pad in the center of the back of the flint to indicate definitely what a hill should look like, then varying lap and stroke accordingly To save making King's test for convexes I drew on my flat making experiences and interpreted the fringes against the concave, for this the concave should be a true surface with a clean edge I finished No 1 surface one fringe off, and No 2 about three off, but this was cemented to the concave

"The objective required about 225 hours of actual work It is second grade Jena and of course has some striae (a pair of guaranteed discs would have cost probably five times as much) Strange to say, it is difficult to trace any irregularities to the striae in actual performance though in the collimation tests they stood out like a sore thumb Under test on the stars the glass is quite satisfactory There is much less scattered light in the field than in my reflector The planets and, particularly, the Moon's detail, stand up much better under high power"

John R Haviland, author of the chapter on objective lens making, in "ATMA," states that he has tested this objective against his 10" flat, and that it tests first-class and has a beautiful polish The anonymity of X is not of his own choosing, it isn't due to shyness, and the G-men aren't after him! Your scribe will forward to him private letters from readers, if addressed in care of this department

William R Harlow, 328 Fisher Hall, Oxford, Ohio, states that he made a 7¾" objective lens, working from Haviland's chapter in "ATMA," which he praises, the job lasting from November to May "The bicon vex crown part was easy," he says, "but I had trouble with the back surface of the flint The unit was quite a bit over-corrected and had to be separated by about 0 1" The definition of the image then was somewhat spoiled by the light reflected back and forth between the surfaces All in all, the lens is all right," Harlow continues, "but I will stay with smaller ones after this."

A 3" is usually about the best size objective for a maiden job, (at least one previous reflector having been made) One man followed this by a 4½", then a 6", obtained good results from all, and has used nothing but these refractors for the past several years

SILVERING isn't extinct, by any means, even though aluminizing today seems superior From C S Walton, 5975 W 44th Ave, Wheatridge, Colo, we recently received word that a method of silvering described in *The Philosophical Magazine* (London), December, 1938, pages 953-970, had been successful in his hands and that he believed it had advantages over the more familiar method On the basis of its origins, also of Walton's praises, we asked him to describe it, which he does as follows

"My attention was directed to an article on silvering in *The Philosophical Magazine*, December, 1938, written by B Dasannacharya and Amar Chand Seth, of the Hindu University, Benares India, which seemed to offer improvements over the familiar Brashear method Trial met with success, so I pass the method and my experiences along

"Clean and prepare the mirrors according to the methods stated in 'ATM'

"Prepare two sets of solutions based on 1 gram of silver nitrate in 2½ oz. water, ½ gram potassium hydroxide in 1 oz. water, and 6 cc regular sugar reducing solution for each 175 square centimeters of area,

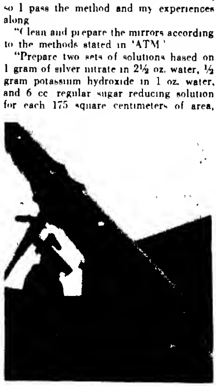


Figure 2. The anonymous refractor

including a dish, if any. An 8" mirror, for example, having 314 sq cm. of area, with a band around it, would be silvered by preparing two solutions, each made of 2 grams silver nitrate in 5 oz. of water, 1 gram potassium hydroxide in 2 oz. water, and 12 cc. reducing solution. The water happens to be an amount that will cover an 8" mirror properly. The two gentlemen of Benares state that the concentration is not important, but that the relation of silver nitrate to area is. They found one gram to 525 sq. cm. to be the best, but with prolonged depositing time I did not get a sufficiently heavy coat and preferred one gram to 175 to 200 sq. cm Other chemicals are, of course, always maintained in the usual ratio to the silver nitrate. Two applications on the basis described will produce a heavy coat.

"Clear the silver nitrate solutions with ammonia, as usual, add potassium hydroxide solution *slowly*, stirring constantly; clear again with ammonia, very carefully. The solutions clear decisively and there will be no turbidity, sediment or black suspended matter left They therefore need no filtering

"Forget the reserve nitrate solution and the instructions to have silver in excess The authors state that the worker should just clear with ammonia each time, and that, in the second clearing, a slight ammonia excess (a drop or two) may be desirable since the coats will be more free from spots and action will be retarded to a convenient rate. Further, they say that temperature is of little importance I can subscribe to the workability of all this.

"The solution on the mirror, to which reducing solution has previously been added, will turn clear brown, then opaque black, then gray, and finally, if left on 10 or 15 minutes, will clear to some extent, and will not form a lot of black muck as it does when using the more familiar methods. Pouring off solutions about the time they turn gray seems to be the dividing line between a bright surface and too much white bloom The wet coat may be washed with mild soap and water to remove bloom and sediment—with reasonable care, of course

"While I use two applications, I do not deliberately strive for as thick a coat as results, because thin coats seem brighter and have less bloom, and after five years' experience with various coats on a 10½" and 12" mirrors, plus a lot of use of the 20" Alvan Clark refractor at Chamberlain Observatory, entirely on faint variables and novae which frequently were beyond reach of even the 20", I have concluded that some thing is wrong with the dictum, 'a thick coat is better in every way' However, double coats produce fewer pinholes for me, which soothes my feelings. Moderately thin coats and thick coats reach about the same minimum star magnitudes in my reflectors, and their performance is exactly proportionate to the 20" refractor in that respect.

"In sum, I consider that the improvements in silvering made in India not only save chemicals, but that the process works clean and precise as compared with the one described in the Bureau of Standards circular quoted in 'ATM' "

FOR the alt-azimuth mounting a wrinkle usually attributed to the Earl of Crawford, and described by S. L. Walkden, of

London, provides a fairly good rough working substitute for the drive clock used on equatorial mountings. Figure 3 is self-explanatory. Walkden writes: "The scheme can be made to work pretty well for looking southward within about four or five hours of

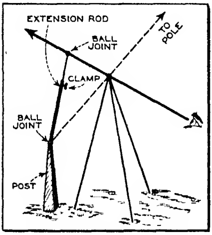


Figure 3. An old alt-azimuth kink

the meridian and up to about 60° North Declination. It generally works suitably enough for about an hour's observation If the eye end of the telescope is slightly over weighted, a cord may be substituted for the extension rod"

IN "ATMA" Everest describes the use of kerosene in place of water for mirror grinding, since the cooling caused by evaporation of water causes temperature effects well worth taking note of in advanced mirror making W A Mason, 1303 Lakeview Avenue, Lorain, Ohio, says he has tried instead some carbon tetrachloride, also "Prestone" anti freeze, diluted about 1 to 1, and believes these are better than kerosene—though he states that he has used them on only one mirror, hence does not wish to make this claim dogmatically He also diluted "Prestone" anti-freeze 1 to 1 with rouge and thought it kept the rouge mixture on the lap better than water, also retarding evaporation Mason is the author of a chapter in "ATMA" (p. 361)

"Prestone" anti-freeze used in automobile radiators, and known to everybody, has an ethylene glycol base and suffers practically no loss by evaporation. In a 1 to 1 mixture of "Prestone" anti-freeze and water, the evaporation, at ordinary temperatures, would be approximately one half that of water alone.

YOU invited some friends over to spend the evening looking at the stars through your telescope They came—whereupon everything clouded up. The friends hung around through an awkward two hours, giving you the dog-eye, as if it were your fault, and you felt like a plugged nickel Then they went home—whereupon all the stars came out.

It hasn't happened to you?

This total depravity of inanimate objects does not catch W. L. Chamberlain, 519 Liberty Street, Meriden, Connecticut, napping. He keeps in reserve a dummy telescope made of cardboard tubing, equipped with indirect lighting and an "eye-piece"—a sort of peep-show—and into this he slips various mounted astronomical pictures, half-tones and drawings from here and there. And he says his friends actually think these look better than the reality!

Well, when you consider that these would be mainly exceptional pictures, corresponding to rare views of the heavens taken with large telescopes, also that most persons who have studied or read no astronomy at all are disappointed when they see the stars through a telescope, because in seeing they see only with their eyes while the amateur astronomer "sees" also with the intellect, then these cut-and-dried pictures probably do look better than reality to your friends, who no doubt would be too polite to say so Of course, one could show such pictures to the visitor even without a dummy telescope, yet there is just enough of the kid in most of us to fall in readily enough with some such guise, just as we do with scenery at a play This saves the evening when guests look reproachful

Chamberlain wasn't, however, the first amateur to try this stunt Holden's biography of Sir William Herschel contains a letter from Sir William to his daughter Carolina, dated July 1782, in which is revealed how Herschel tried it on King George III and his Queen when they came to look through his telescope (George III became a good amateur astromoner later on, even though as a King we Yankees think he wasn't so hot) "When the evening appeared to be totally unpromising," Herschel wrote, "I proposed an artificial Saturn as an object I had beforehand prepared this little piece, as I guessed by the appearance of the weather in the afternoon we should have no stars to look at This being accepted with great pleasure, I had the lamps lighted up, which illuminated the picture of a Saturn cut out in pasteboard at the bottom of the garden wall The effect was fine, and so natural that the best astronomer might have been deceived Their royal highnesses and other ladies seemed to be much pleased with the artifice"

CONVENTIONS of amateur astronomers will be held Friday-Sunday, July 5-7, at Buhl Planetarium, Federal and West Ohio Sts, Pittsburgh, Pa, by the Amateur Astronomers Association of Pittsburgh, H. Clinton Kyle, General Chairman, also Saturday, August 10, at Stellafane, near Springfield, Vt, Roy J Lyon, Secretary All are welcome to both gatherings.

NEWTELLIAN is the name given by John M Pierce, 11 Harvard St, Springfield, Vt, to a reflector having a small diagonal just outside the incoming beam of rays, which he has described in one of his bobbygraphs.

ADVANCED optical design sharks will be interested in a 13 page article on "The Design of Wide-aperture Photographic Objectives," by R. Kingslake, of the Eastman Kodak Co., in last January's *Journal of Applied Physics* (175 Fifth Ave, New York). Trends is the main thread in this

FROM *The Journal of the Royal Astronomical Society of Canada,* 198 College St., Toronto, Ont., can be obtained, for a quarter, a practical booklet on "The Small Observatory and its Design," by Bry-don, who contributed to same journal in 1939 an article describing "Two Inexpensive Drives for Small Telescopes," one drive being especially interesting. Same cost.

Conducted by JACOB DESCHIN, A.R.P.S.

Making The Most of Your Vacation Shots

THIS piece may seem to be more appropriate at the end of the vacation months, when we have all gathered what vacation pictures we are going to be able to make this season. However, though it may seem like putting the cart before the horse—discussing print making before we have shot the negatives—this department would like to submit that many a picture would be much improved if the final print were kept in mind even as one is shooting the original subject.

The illustrations reproduced here are the work of Miss B. S. Shannon, a member of the London Terrace Camera Club (New York) and represent two of a large number of negatives she made during a trip to Mexico, that land of limitless picture opportunities. The sermon that Miss Shannon's pictures suggest for this month is that a single negative may often yield more than one picture, even though a print from the full negative may itself be worthy.

Figure 1

Miss Shannon uses a negative format longer in relation to its width than most amateurs are accustomed to work with; as a result, they cannot be enlarged, without cropping, to the usual 5 by 7, 8 by 10, and 11 by 14-inch formats the standard printing papers call for. One of the best examples in her collection is Figure 1, which depicts two moods in a single scene: the busy market place in the street and the tranquility and dignity of the church on the hill above. Although the two moods might appear to clash, together they present the characteristic flavor or "mood ensemble" that we have come to associate with Mexico. As it stands, the picture has definite charm and undeniable appeal. It is very well worth while. We like it.

Figure 2

However, the negative does lend itself to dismemberment, as Figures 2 and 3 will illustrate. In Figure 2 the concentration is on the market-place, in Figure 3 the church and sunlit rooftops occupy the full picture.

Not all negatives, of course, are so easily separated into two or more pictures. In many cases it is difficult to get even one good picture out of a negative which has been shot without any sense of composition or appreciation of the fact that a picture must have a point of interest and an arrangement in which the various elements are pleasingly balanced.

Another type of negative in which a certain effect was desired but which fell flat because of one circumstance or another, is shown in Figure 4. The goal of the photographer was to shape the three persons (plus the baby) into some story-telling picture, but things did not work out as desired. The baby probably became upset for some

Figure 3

Figure 4

reason, and the mother and boy had their attention diverted. The only saving feature of the picture is the smiling worker leaning on a shovel. By judicious cropping, an interesting picture was salvaged from an apparent failure.

Despite all precautions you may take and all the care put into the making of a negative, pictures in which persons are included,

Figure 5

and particularly where they are shot candid-wise, often will prove disappointing. But do the best you can, always keeping in mind that negatives do not have to be printed just as they are exposed but may frequently be "edited," as our movie colleagues have it, to produce at least one picture from a piece of the negative, even though the larger portion of it may be worthless. Sometimes, too, we are obliged, by reason of the angle of view encompassed by the lens, to include more than we desire. Again we do the best we can and keep in mind that when we come to making the enlargement later we can take what we want and let the rest go.

Prepared Solutions *vs* Mixing Your Own

THE question often arises as to whether it is better to buy developing solutions already made up or to mix one's own solutions. Louis H. Lanctot, A. R. P. S., of the Center Photo Stores, Inc. (New York), recently commented on this subject as follows:

"The only advantage of mixing one's own solutions," he said, "is that it is a little cheaper. Sometimes, too, there arises the need for a special formula to do some particular work and having a stock of chemicals on hand makes it very convenient. But on the whole there are good reasons why the photographer should purchase his solutions. The manufacturer mixes the chemicals in large quantities and this reduces any errors in weighing. Again, the mixing operation is carried out in a scientific manner under the supervision of trained chemists and there is no chance for the solution to go wrong. The small additional amount expended on a prepared solution is the price you pay for a chemical engineer to help you, as well as insurance that your solution will work satisfactorily."

Stainless Equipment in Amateur Darkrooms

THE qualities of stainless steel that have made it indispensable to industry also are responsible for its growing popularity in photography, writes George J. Sherwin, well known amateur photographer, in a recent communication to this department. Its resistance to chemical action, its cleanness, and its great strength are, in fact, qualities ideally suited to the requirements of photographic work. Profession

In the darkroom—stainless steel tanks, tray, film driers, and so on

als soon discovered that equipment made of this metal was both convenient and economical, requiring but little care and no replacement. The amateur, as usual, was not far behind the professional. He too clamored for tanks and trays made of the metal that neither tarnishes nor corrodes — that lasts a lifetime. That he knew what

Print washer with stainless frame

he wanted is evident from the great amount of stainless-steel equipment to be found in the average amateur darkroom today.

One of the better known applications of stainless steel to photography can be found in film developing equipment such as the "Nikor" developing tank The tank probably has to take as much punishment as any other article in the darkroom and therefore must be made of a material that combines many virtues It must be impervious to the corrosive action of the developer, even if only a slight reaction takes place, fogging or other spoilage of the negative may occur Then, too, the tank must have a hard, non-porous surface so that it will not retain deposits which, by contaminating the solution, might also cause spoilage The stainless steel tank, smooth and non corrosive, fully meets these requirements Moreover, its great strength is another valuable characteristic

In addition to fulfilling all these demands of photography, stainless steel equipment offers other advantages in the way of convenience and economy Its heat conductivity is favorable because a stainless container tends to keep the liquid in it at a constant temperature, free from rapid fluctuations It is easy to keep meticulously clean simply by rinsing out. Economy, too, is an angle that the amateur is not likely to overlook Stainless steel practically lasts forever because of its high tensile strength and corrosion-resisting characteristics.

Many new darkroom accessories of stainless steel are now available. Stirring rods, trays, negative driers, print washers, and thermometers represent only a few of them. One of the most popular is the new type print washer shown in the illustration. It utilizes an entirely different principle which insures both rapid and thorough washing by running fresh water over the prints which are held between its absorbent book-like leaves.

That stainless steel is taking over the American darkroom seems to be an incontestable fact. Some amateurs have even

completely lined their darkroom sinks with it, hiring a local tinsmith to do the job But for the present, however, most amateurs are content to take advantage of the many conventional items now available.

Re Flat Prints

A CURE for those curling prints most of us keep complaining about is offered by John H. Cornwall He says it took him all of his 18 years in photography to discover it, but believes he has the solution now. After washing the prints thoroughly, he immerses the prints in the following bath.

Glycerin	12%
Alcohol	5%
Water	83%

He recommends this after rinse particularly in the case of prints that are to be ferrotyped Upon drying, the prints fall off the tins flat and without any signs of the corrugations and non glossy circles that make ferrotyping such a chore and exasperation for some workers

WHAT'S NEW
In Photographic Equipment

If you are interested in any of the items described below, and cannot find them in our advertising columns or at your photo graphic dealer, we shall be glad to tell you where you can get them. Please send a stamped envelope with your request

Kodak Portable Miniature Enlarger ($42.50 to $60 with lens) Designed for 35mm camera users who lack darkroom or who travel Packs and dismantles readily in airplane-luggage type case measuring 13½x 13½x6½ inches. Can be unpacked and set up ready for use in few minutes in any improvised darkroom. Enlargements from 2½ to 9 diameters on baseboard; still greater enlargements by projection to floor or wall Enlarger head may be rotated 90 degrees to right or left Scale graduated in degrees indicates angle off vertical Combines diffuse and condenser illumination by employing No. 113, 50-watt, 115-volt Mazda Photo Enlarger Lamp in conjunction with triple-lens condensing system. Lenses available Kodak 50mm Projection Anastigmat $f/6$ 3 in lens tube, fixed diaphragm; Kodak 2-inch Projection Anastigmat $f/4$ 5, adjustable diaphragm stopping down to $f/22$· Kodak Projection Ektar $f/4$ 5, adjustable diaphragm and click stops to $f/22$, latter lens designated for color-separation work as well as black and white. Baseboard 13 by 13 inches, takes printing paper up to 8 x 10 inches Carryall case has three extra compartments, one with hinged cover and cloth lining, providing storage space for additional equipment

Fedco Bantam Spotlite ($7 95 less lamp, lamp, 85¢). Miniature type spotlight using 100-watt T8 projector bulb, 115-v Beam range adjustable from small spot to full flood Small, compact, lightweight Made of die-cast aluminum Completely ventilated. Adjustable handles and knobs of non-heat conducting plastic Micrometer type focusing New type 3-inch Fresnel heat-resisting lens. Short focal length of lens permits wide variation of beam width. Op

erates on 3200 degree Kelvin, making it adaptable to color shots as well as black and white Chrome-plated, non-tarnishing focusing reflector Has built-in standard tripod socket. American made

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HAYNES SALON MICRO-MATTE Enlarging paper with same silver-loaded emulsion as Haynes Salon, but with the coating placed directly on a fine-grain paper base Designed especially for portraiture and precise rendering of delicate detail

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CHROMO - UNISOL DEVELOPER TONERS ($1 75) Develops and tones prints in one operation Prints are dried in usual manner, either on ferrotype plates or drum dryer Choice of sepia, blue, green, and magenta

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PRINCETON PRECISION GLASS FILTERS (85 cents to $1 50) Made from dyed-in-the-mass glass Said to be "absolutely flat, meaning that there are no bumps or hollows in the surface, not even to 1/1000th part of an inch" Available in following colors Yellow 1, 2, and 3, Red 1 and 2, Green 1 and 2 Ultra violet, Orange, and Infra-Red Sizes 19 to 42mm

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GEM PORSO GLAZE (25 cents) In white or black For waterproofing and coating Used as surface preservative on darkroom trays and tanks and other darkroom items that are prone to rust, chipping, and cracking

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DU PONT SUPERIOR 1, 2, 3 Three new Du Pont 35mm films Superior 1 intended for outdoor use Extremely fine grain, long scale, specially color sensitized for exposure by daylight Areas of sky register as printable densities without use of filter Speed about same as Superior Pan formerly supplied for miniature cameras Superior 2 twice as fast as Superior 1 For use outdoors in cameras having slower lenses, regardless of weather conditions, and indoors for scenes and portraits with controlled lighting Color response corrected for incandescent light source Grain size finer than old type Superior Pan Superior 3 high-speed film intended primarily for interior use where lighting is not controlled Color sensitivity takes advantage of tungsten illumination Grain size about same as former Superior Pan Forced development increases effective speed of film, making exposures possible at Mazda rating of 100 Weston

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POCKET-PACK BULB KIT Holds six G E Synchropress No 5 Midget Photoflash bulbs Made of heavy cardboard about size of ordinary tobacco tin Bulbs held apart in perforated cardboard belt which slides into heavier protective cardboard sleeve

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SOLAR SLIDING LENS BOARD ($4 75) Mounts three lenses of different focal lengths permitting instant placement of any lens into optical center of enlarger Sliding unit measures 9¼ by 2¾ inches with ⅝-inch lens clearance at back Mounts directly to lens board receptacle of enlarger Will take lenses from 3 to 7¼ inch focal length. Fits all Solar enlargers except Junior Model.

CAMERA ANGLES ROUND TABLE

JACOB DESCHIN, conductor of our "Camera Angles" department, will answer in these columns questions of general interest to amateur photographers If an answer is desired by mail, enclose a stamped, addressed envelope Queries should be specific, but Mr Deschin cannot undertake to draw comparisons between manufactured products nor to advise on the purchase of equipment or materials —The Editor.

***Q.* A certain studio turns out portraits with a bronze tone, which gives the subjects in the portrait a very pretty flesh tone and is subsequently easier to color. Will you please tell me if this tone is achieved by toning? If so, will you please give me a formula and also the type of paper most suitable for this kind of work.—G. G**

A The photographer in question undoubtedly uses a gold toner Agfa Flemish Gold Toner is a prepared product that appears to be generally liked A good formula is the Nelson Gold Toning Bath (Kodak T-21) A variety of tones may be achieved with these toners and you will have to do some experimenting to obtain exactly the bronze tone you refer to Chloride or chlorobromide papers, preferably white, may be used

***Q.* Some months ago I bought a miniature camera with a fast lens. The other day I discovered two small marks about the size of a pin point; they appear to be pits on the front lens. Can you tell me what effect this will have on negatives made by this camera? I have noticed no defects on the ones I have made. I photographed a sheet of newspaper and there was no diffusion in any part of the print. Is such a test of any value?—G. E. A.**

A The only test of lens performance that is at all useful to the photographic worker is the negative made with it Therefore, if your negatives look satisfactory, the pits you speak of apparently have no effect and you may continue to use this lens in full confidence. The newspaper test is a very good one because, containing sharp details over the entire surface as it does, defects are easily noticeable. To satisfy yourself completely, we would suggest that you make good sized enlargements from these newspaper negatives and study the resulting prints.

***Q.* Recently I cemented in Canada balsam a tricolor gelatin filter set in 40mm glass circles. The red filter is almost perfect, the green filter is very slightly hazy. and the blue filter turned out to be useless as the diffusion increased to a point where it gives a double image. I have made two sets of these filters with the same gelatin, balsam, and glass and the order of diffusion is remarkably identical What do you think could be my trouble?—R. M.**

A. The difficulty may lie in one or more of the following factors the quality of the glass may not be good (it should be plate glass of selected quality), the balsam may not be of a good grade; the cementing or the binding of the gelatin between the glasses may not have been properly done, the bound filter may not have been allowed to dry long enough (it may sometimes take as long as 10 days) If you will check over these various possibilities, you will probably find the answer to your trouble

***Q.* My camera uses 127 film and I have a developing tank for it which uses eight ounces of solution at a time. 1. Do you know of any developer in concentrated form on the market which is prepared for only eight ounces for tank use? If not, do you know any formula for a developer suitable for tank use, which could easily be prepared for only eight ounces at a time? 2 Approximately how many rolls of 127 films will a quart of acid hypo fix, using D-76 developer and leaving films 15 minutes in hypo? 3. Does the exposure or the developing determine the contrast for the resulting prints? In other words, will each exposure on a roll have a different contrast or will they all have the same contrast?—B. Y.**

A. 1 The smallest volume in which concentrated developer solution is available for fine grain work such as you require is 16 ounces Panthermic 777 is available in eight ounces but only in dry form. Any developer formula can be scaled down for an eight-ounce solution It is simply a matter of dividing the larger volume stated in the formula 2 We do not have the exact figures, but the general attitude of workers is that, since hypo is so very cheap, why not use it liberally to insure proper fixation? On this basis we would say that up to five or six rolls for each eight ounce volume should be the maximum 3 Exposure determines the gradation of tone, development time determines the contrast, the longer the development time the greater the contrast, the shorter the period the weaker the contrast. The degree of contrast will be the same throughout the roll.

OUR BOOK CORNER

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THE SCIENCE OF PSYCHOLOGY

By Raymond H Wheeler, University of Kansas

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By Henry H. Tryon

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—*A D R, IV*

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Edited by Neil B Reynolds and Ellis L. Manning

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CHEMICAL SPECTROSCOPY

By Wallace R Brode, Professor of Chemistry, Ohio State University

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AEROSPHERE

Edited by Glenn D Angle

THIS book presents an up-to-date statement of the main characteristics of the world's aircraft engines, indexed according to nationality. The main characteristics and specifications of almost all well known engines are presented, with suitable illustrations of each engine Similar summarized information is presented for airplanes, although in less detailed form An important section gives records, directories of schools, various governmental bodies, flying statistics, and so on The last section of the book includes an aircraft directory listing manufacturers of planes, engines, and accessories The whole constitutes an excellent work of reference with obvious utility for all those having contact with the aircraft industry or wishing to keep up-to-date regarding this industry. (1420 pages) —$16 00 postpaid—*A K.*

PHOTOGRAPHING IN COLOR

By Paul Outerbridge, Jr

AN acknowledged master of color technique has written a thoroughly practical guide for perplexed color photographers, both rank beginners and those more

We can supply our readers with any of the books reviewed in this department. Prices quoted include domestic postage. Foreign prices are necessarily higher due to increased shipping charges.

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advanced. To the amateur photographer, Mr. Outerbridge is known chiefly through exhibitions of his color work in photographic salons, where his prints always excite the greatest admiration. This book contains the fruits of many years of practical work in the field of color photography, his personal selection of medium being Carbro, and is written in a style that is easy to read, using language that is clearly understandable. One of the most attractive features of the book is the inclusion of 16 full-page, four-color reproductions of his work. The text, which is divided into two parts, discusses the relationship of color to photography, cameras and camera equipment, lighting and exposure, composition and picture material, and the use of color transparencies. The second part of the book is concerned with the laboratory set up for color work and making separation negatives and full color prints by various processes. (204 pages, 8½ by 12 inches, 16 full color illustrations.)—$4.95 postpaid.—*J. D.*

THE CHEMIST AT WORK

By Roy I. Grady, John W. Chittum, Professors of Chemistry at the College of Wooster, and many others

YOUTHS who think they would like to become chemists wonder just what it would be like to be one—what kind of daily life they would lead. There are many specializing varieties of chemists and in this book about 50 varieties have contributed chapters telling what their work really is like. For example, plant chemists, nutrition chemists, soil chemists, government chemists, chemistry teachers, lubrication chemists, woman chemists, and so on and on in wide variety. A high-school youth, after reading this book, would pretty surely know the answer and not just guess vaguely, perhaps mainly emotionally, at it. Non-technical, of course. (455 pages, 5 by 8 inches, illustrated.)—$3.10 postpaid.—*A. G. I.*

CAMERA, TAKE THE STAND

By Asa S. Herzog and A. J. Ezickson

EXCITING as a detective story, yet factual in content, is this comprehensive running story of the uses to which photography is put by law enforcement officers. In finger-print work, in recording details of the scene of the crime, in identifying firearms and bullets, and in many other ways, photography aids in the work of criminologists. The authors have based their text on actual cases and have used a large number of illustrations taken directly from evidence files. They discuss the means as well as the end product; how the photographic work is done and how the resulting pictures are used. (194 pages, 6¼ by 9¼, a large number of photographs and drawings.)—$3.10 postpaid.—*A. P. P.*

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YOUR FIREARMS and FISHING TACKLE

Conducted by A. D. RATHBONE, IV

INTEREST IN FIREARMS *is traditional with American men, fishing tackle is a requisite of one of the world's oldest occupations Scientific development of guns and tackle, in the use of which millions yearly find sport and recreation, fathers this monthly department, which welcomes correspondence from readers*

Gun Collector's Philosophy

SOME men are, by avocation, carpenters, fly-tyers, mechanics, horticulturists, while others delegate such specialized tasks to professionals and invest their leisure in various pursuits It's all a matter of personal preference, and so it is in gun collecting The collector, or his agent, may acquire magnificent specimens through contact with legitimate, trustworthy, antique dealers, through museums, or by attending auctions For these he may pay large or small sums, and more often than not the arms which find honored places in his gun room have been cleaned, reconditioned, and prepared for display

Not so with Major Lenox R Lohr, President of National Broadcasting Company His gun collecting philosophy begins with

Major Lohr and guns

the personal discovery of a specimen, tucked away in some dark cranny of a junk yard, an attic, an old barn, or other casual source, and ends with the investment of a prodigious amount of elbow grease expended in cleaning, refurbishing, and repairing the firearm in an effort to restore it to as near its original status as possible Somewhere in between these extremes there has occurred a bit of keen, good-natured bargaining which ended in payment of from one to four dollars for the desired specimen, for, says Major Lohr, "Contrary to popular belief, you don't need a wallet-full of money to begin a firearms collection" As proof of the Major's contention, every rifle, revolver, pistol, and shotgun in his collection is in working order, is capable of firing the load originally designed for it, and his largest investment in any single piece has been $4

Major Lohr's collection of U S. military rifles, thoroughly reconditioned in his own workshop, has provided him with many hours of pleasant relaxation, knowledge of the details of varied constructions, and the satisfaction of having proved that anyone can pursue the hobby of gun collecting for an insignificant expenditure ·In fact, the Major points out, an old gun, purchased for a dollar or two, thoroughly cleaned and repaired, pays dividends on the investment by being of greater value to someone and by increasing the collector's knowledge of the history and mechanics of firearms through the research, study, and effort expended in restoring it Many an American lad, he says, has earned spending money through harder labor than is involved by subscribing to his philosophy of gun collecting

Outstanding among the Major's firearms is a group of American military rifles which depict the evolution of the breech loader Included are a Springfield muzzle loader of 1837, converted from a flintlock, an 1840 North gun with rising breech for separate loading of powder and ball, a Burnside rifle for separate ball and powder, with percussion cap and tapered breech seal, a Starr rifle of 1858, built for paper cartridge, the end of which had to be bitten off to expose powder to percussion cap, an 1859 Sharp's rifle, with percussion cap equipped with clipper to cut the end of the paper cartridge, an 1861 Ballard rifle, for rim fire fixed cartridges, a Spencer breech loading repeater of 1865

Are Fish Color-Blind?

IT'S an old but ever new discussion as to whether fish are color blind, yet Dr Frank A Brown, Jr, assistant professor of zoology at Northwestern University, recently conducted a series of experiments which would appear to have settled this antique argument It seems the good Doctor caught some bass in an Illinois lake, put them in large, white enameled basins, and proceeded to feed them with pipettes, or common medicine droppers, which had been covered with adhesive tape tinted in various colors The joke was on the fish, however, for from one pipette only did they obtain food All others were electrically wired so that the bass received a mild shock as he nosed into it.

But now came the convincing part of the demonstration Different fish were trained to obtain food from different colored pipettes When the bass had completed their "training period," the experiment began. A deliberate attempt was made to confuse the "trained" bass by offering them pipettes in new and unfamiliar colors, and various tints and shades of the colors to which they had become accustomed, but it didn't work Dr. Brown's bass were unerringly able to select the pipette from which they had been taught to expect food, even to picking out the "soup's-on" pipette from a confusing series of grays. Red, it seems, is the most

distinct color a bass sees, followed by green, yellow, black, blue, with black and blue appearing more nearly similar than any other colors. Despite the results of Dr Brown's experiments, there will be many anglers who insist fish cannot distinguish colors and that the use of multi colored lures is merely an attempt to beguile the fisherman, not fish What do you think?

Duck Stamps for 1940

THE 1940 "Duck Stamp," which must be purchased for $1 by all migratory water fowl hunters over 16 years of age, will be available to the public at all 1st and 2nd class post offices July 1 This year's design, by Francis L Jaques, shows a brace of black ducks flying down wind over a marsh area, with wild rice in the background The Bureau of Biological Survey receives 90 percent of the money from Duck Stamp sales to supplement other funds for purchase and maintenance of waterfowl refuges, and the remaining 10 percent is used for printing and distributing stamps, administrative purposes of the Migratory Bird Hunting Stamp Act, and for other Federal activities relative to migratory bird conservation

Technology in Rod Making

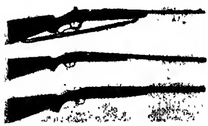
LAST month we delved briefly into rod making, mentioning some of the early artisans who were pioneers in the six-strip construction so largely in vogue today With 12 million American anglers wetting lines in streams, lakes, and oceans, however, some of the former handwork on rods must now be done by machinery in order to meet the tremendous demand By no means should this be construed to indicate that the niceties of skilled workmanship have been lost through technological advances

To the contrary, at the South Bend Bait Company factory, for example, specially designed machines, so true in operation that variations of 001 of an inch are unknown, convert the split sections of bamboo into perfect triangles By a gradual taper from one end to the other which later governs the action of the finished rod, it is possible to produce segments which not only are minutely uniform, but which pass micro metric inspection Some conception of the exactitude of this machinery may be gained by realization that in some rods 12 pieces of cane are used instead of six, thereby producing a rod within a rod Likewise, the South Bend Bait Company constructs what is known as a "Triplebuilt" rod from 18 laminated segments of cane, and even goes further to produce their Cross "Bow Stave" big game fishing rod, shaped from more than 40 flat strips of outside bamboo enamel, laminated and glued under pressure

But the important point to remember is that these sections, or "sticks" as they are known to the tackle trade, must remain in seasoning vaults at least 1½ to 2 years before they are finally fashioned into a rod Only after this seasoning period can such hand operations as straightening, cleaning, balancing be done. Each section must be finished to pre-determined calibrations, checked every 2½ inches on the circumference of the rod. Is it any easier now to understand why a fine rod cannot be turned out in a day?

Pot-Shots
AT THINGS NEW

FOX, SAVAGE, AND STEVENS 1940 catalogs are off the press and each presents an array of guns to delight the hand and eye of the most critical and fastidious gunner They're all there, from the ever-reliable little Stevens 22 single-shot to the Fox FE Grade, double-barrel shotgun in all its breath taking beauty and symmetry To mention but a few innovations incorporated in the 1940 products, Fox Model B, made in 12, 16, and 20 gages last season, is also available this year in .410 bore, chambered



Savage Fox .. Stevens

for 3-inch shells in 26-inch barrels This light weight, popular priced, hammerless double met such enthusiastic acceptance when brought out last year that additional barrel lengths may now be had The 16 and 20 gage guns come with 26 and 28 inch tubes, while the 12-gager may be obtained with 20-inch barrels.

In the Savage line, new rifle for 1940 is Model 602, similar in design to the "3 way" Model 6, except it is chambered for 22 shorts only As an automatic, it will handle 22 short regular or hi-speed cartridges with lubricated bullets, as bolt action repeater or as single shot, it takes any .22 short cartridges The 99-H Carbine, with 22-inch barrel, is now chambered for the 300 Savage cartridge, as well as for the 250-3000, 30 30 and 303, but with 20 inch barrel for last three Model 99-RS is now regularly equipped with Redfield No 70 adjustable rear peep sight, folding leaf middle and gold bead front sight, has ⅞ inch combination adjustable leather sling and carrying strap with quick release swivels Model 40 Super Sporter has checkered, capped, full pistol grip, checkered fore end Models 23-AA, 23-B, C, and D come equipped with ⅞ inch sling loops, are likewise checkered on grip and fore end In automatic shotguns, Models 720-P, 726 P, and 740 P have as standard equipment new Aero Dyne Super Poly Choke built integral with barrel and Bev-L Blok front sight

Model 762 is Stevens' new 1940 offering Comparable in design to popular Model 76, which handles 22 L R cartridge, the new gun is also automatic, but is chambered for 22 shorts The No 620 repeating scattergun in 12, 16, and 20 gages has been redesigned to eliminate upper tang from frame and to provide streamlined frame and stock, which now has full capped, checkered pistol grip Same gun, but known as 620-P, comes with new Aero Dyne Super Poly Choke built integral with barrel Stevens 22 caliber repeaters and automatics are drilled and tapped for Weaver 'scope sights, eliminating factory fitting process Public reaction to use of the plastic, Tenite, on Model 530-M shotgun for stock and fore end has been so satisfactory that No 22 410, over and-

under combination rifle and shotgun will be similarly equipped later this year. We discussed use of Tenite in December, 1939, issue (Vol. 161, No. 6) and have severely tested our own Tenite-stocked Model 530-M It not only "shoots sweet," but also can "stand the gaff." The Fox-Savage-Stevens parade of guns is on, and catalogs are available Which will you have?

AMERICAN OPTICAL COMPANY offers relief to fishermen from dazzling sun by filtering out reflected glare rays through their new AO Polaroid Day Glasses, which help to locate fish before they locate you With better vision and ability to see the big ones strike, it's easier to set the book Skeet shooters, too, should find AO Polaroid glasses of great benefit

FROM INQUIRIES we've had, there must have been something very alluring about Smith & Wesson's new .22 cal target re-

volver, "Model K 22 Masterpiece" Here's a picture which will prove it has "oomph", we still have a few K-22 folders

MOHAWK PRODUCTS COMPANY has borrowed a leaf from Galileo and developed a telescopic peep sight as an improvement over standard peep disks on receiver and tang sights Combining two precision ground plano-convex lenses, one of flint, the other of crown glass, Mohawk has achieved a telescopic effect with a field which is bright and free from the blur often found to some degree in peep disk use Total length of Peep 'Scope at normal focus is just under one inch, thread diameter of shank is 7/32 with 40 thread, or 218-40, which fits all standard peep disk holes except Marble, but which does fit the Marble-Goss Diameter of object lens is 8mm and that of ocular lens is 4mm. Width of field varies according to distance which 'scope is mounted from eye. Based on a 100-yard range, with 'scope four inches from eye, field is about 12 feet, increasing until, with 'scope two inches from eye, field is about 25 feet C. B Mitchell, of Mohawk Products, tells us that every lens is rigidly tested and that with normal eyes, or fairly well corrected eyes, and with 'scope set at full magnification on distant object, newsprint can be easily read at 24 inches with same focus "This," he says, "means the front sight shows up very clearly, while distant objects are twice as plain as with the unaided eye."

W. R. WEAVER COMPANY, makers of 'scope sights for target and hunting rifles, as well as that Weaver IX shotgun 'scope of benefit to so many scattergun shooters, announces their new Weaver-Choke, developed to (1) eliminate "blown" patterns; (2) reduce recoil, (3) adapt one gun to 20 to 70 yard shooting. Choke has series of baffles in bore to catch and divert through numerous vents gases which are released before shot leaves gun muzzle, thereby reducing pressure on shot column and minimizing muzzle blast. This, in turn, cuts down disturbance to shot, which, directed by the choke, continues forward, resulting in even and uniform patterns. Reduction of recoil is also accomplished through baffle rings and gas vents. High velocity powder gases strike baffles, giving forward thrust, which reduces recoil

Weaver-Choke is made of strong aluminum alloy, weighs no more than section of barrel removed, won't change handling or balance of gun, is finished with special process which gives bore a diamond-like

A group of Weaver-Chokes Tallest one is full choke in baffle tube

hardness and perfect surface for passage of shot The six chokes, which may be changed in a few seconds, were designed as to length, shape, taper, constriction after exhaustive tests for following individual purposes

Extra Full Choke—extremely close patterns averaging 85 percent for long range shooting, even to ducks at 70 yards, if shooter does his part Full Choke—shoots about 75 percent, or same as standard, full-choke gun For ducks to 60 yards, long shots at doves, desert quail to 50 yards ¾ Choke—small game at 40 to possible 45 yards For ducks from blind, western quail, Bobwhite, rabbits ½ Choke—fairly wide shot spread; dependable small game killing to 35 yards Bobwhite, rabbits, doves, and all shooting where range is not extreme. ¼ Choke—wide pattern for wooded, brushy country where shooting is fast, close, and range not over 30 yards. Skeet or scatter—designed expressly for skeet with wide, even pattern and full coverage on 30-inch circle at 20 yards. For single ball or slug loads.

Weaver Choke is now ready in 12 gage, available in other gages in July, is adaptable to all autoloading, pump, and single barrel shotguns, either plain or ribbed, can be attached by any good gunsmith or at Weaver factory

SCOPE POINTER COMPANY offers new 1½-pound aluminum alloy folding tripod, with machine parts of steel and brass, guaranteed to support 75 pounds. Scope remains attached to cradle, which is fastened to tripod by large, single thumbscrew, may be instantly set to any angle of offset; is controlled rapidly, accurately at ground level

Scope pointer tripod, showing the cradle that holds the scope, and rear leg with controls

by two revolving drums, integral with rear leg of tripod. Rotation of upper drum directs horizontal adjustment, while lower drum swings scope vertically. Legs are adjustable to any angle, have 12-inch spread at ground level, allow more elbow room in prone position. Compactness when folded, centralization of controls, adaptability to any type optical equipment are additional appeals.

LEGAL HIGH-LIGHTS

Patent, Trade Mark, and Related Legal Proceedings That May Have a Direct Effect on Your Business

By ORSON D. MUNN, Litt.B., L.L.B., Sc.D.
New York Bar
Editor Scientific American

AFFIRMATION

THE decision establishing a radically new principle for computing profits in suits for copyright infringement discussed on this page under the heading of "Apportionment" in the January, 1940, issue of Scientific American has been affirmed by the United States Supreme Court. In affirming the decision the Supreme Court held that in computing an award of profits against an infringer of a copyright there may be an apportionment so as to give to the owner of the copyright only that part of the profits found to be attributable to the use of the copyrighted material.

The copyright statute provides that an infringer of a copyright shall be liable to pay to the copyright proprietor such damages as the copyright proprietor may have suffered or "all the profits which the infringer shall have made from such infringement." Prior to the present decision the courts have generally construed this provision of the law as entitling the copyright proprietor to recover from the infringer all of the profits resulting from the sale or production of an infringing work even though some of the profits might properly be attributable to factors other than copyright infringement.

In the present case the Court found that a motion picture produced by the defendant infringed a copyrighted play owned by the plaintiff. The total profits realized by the infringer were found to be a little more than half a million dollars. The infringer introduced the testimony of experts showing that the plot and story contributed in but a small measure to the production and success of the motion picture. The experts testified that the main factors in producing the large profits were the popular actors, the artistic scenery, and the expert producers and directors. This testimony was apparently not rebutted by the copyright proprietor and accordingly was accepted by the Court as indicating the approximate contributions made to the success of the moving picture by the copyrighted material on the one hand and by the infringer on the other hand. As a result the Court awarded only 25 percent of the total profits realized by the infringer to the copyright proprietor.

In reaching its decision the Supreme Court pointed out that it had been the custom for many years in patent infringement suits to apportion the profits in accordance with the approximate proportions resulting from the infringement and from extraneous contributions made by the infringer. The court concluded that there was no reason why the same principle should not also be applied to suits for infringement of a copyright.

The section of the copyright law providing that the infringer shall be liable to pay "all the profits which the infringer shall have made from such infringement" was held to mean that only the profits resulting from the use of the infringing material shall be paid to the proprietor and that profits resulting from extraneous matters were not payable to the copyright proprietor. The Court held that "when such an apportionment has been fairly made, the copyright proprietor receives all the profits which have been gained through the use of the infringing material and that is all that the statute authorizes and equity sanctions."

FTC INJUNCTION

THE Federal Trade Commission for many years has had power to restrain unfair methods of competition in commerce. More recently, the Commission has been given power to restrain unfair or deceptive acts or practices in commerce. In the usual proceedings the Commission issues a complaint against a party who is charged with using unfair methods of competition or unfair or deceptive acts or practices. If, after testimony has been taken, the Commission finds that the party is guilty, it issues an order requiring him to cease and desist the unfair or deceptive acts or practices.

Naturally, considerable time must elapse between the serving of the complaint and issuance of the order to cease and desist because the party complained of must be given an opportunity to file an answer, testimony must be taken, and due consideration must be given to the testimony. In the meantime the party may continue the practices complained of. In certain instances the continuance of the act complained of prior to the issuance of the order will be extremely detrimental to the public interest and under an amendment to the Federal Trade Commission Act the Commission has been given power to apply to a Federal Court for an injunction to restrain the wrongful act.

The ammendment to the law provides that where it appears that it would be in the interest of the public, the Commission, pending the issuance of a Complaint, may apply to a district court of the United States to enjoin the dissemination of any false advertisement and that upon a proper showing a temporary injunction shall be granted without a bond. This is an extraordinary remedy since the party is restrained from committing the acts complained of prior to an adjudication of the issues by the Federal Trade Commission. Naturally it is only resorted to under unusual circumstances where the public interest is involved.

An example of a proceeding under this section of the law is found in a recent case in which an injunction was granted to restrain false advertising in the sale of cosmetics through a puzzle promotional scheme. It was charged by the Commission that a company selling cosmetics initiated its sales by means of a puzzle contest for which a prize of $50 would be paid for a successful solution. When a contestant sent in a solution it was alleged by the commission that he was notified that his entry had passed a preliminary check-up and was before the final judges. If a payment of $3 was submitted by the contestant he was advised that he would receive five dollars worth of cosmetics and if a so called "promptness prize blank" was returned within a designated time there would be a chance to win a cash prize in the amount of $1250 and an automobile.

The Commission charged that the entire plan was devised for the purpose of selling cosmetics which were of inferior quality for which the purchaser would have no use and which could not be resold without loss. The Commission also charged that the defendant corporation was a reincarnation of a former corporation which promoted the identical sort of sales scheme and which had dissolved in a short time to be succeeded by another corporation, all for the purpose of avoiding the provisions of the federal laws and evading the Federal Trade Commission. Under the circumstances the Commission argued that to protect the public interest it was necessary to enjoin the company at once, prior to the issuance of a complaint. The Court sustained the contention of the Commission and restrained the company from circulating the advertising relating to the sale of cosmetics through a puzzle promotional scheme.

EMANCIPATION

A SUIT charging unfair competition was brought by the author of an outstanding play dealing with the life of Abraham Lincoln against the producer of a moving-picture drama also based on the life of Abraham Lincoln.

The suit in question was unusual in that it did not charge plagiarism or copyright infringement but was based solely on the theory that the author had dispelled the public apathy with regard to the life of Abraham Lincoln and had caused a recrudescense of lively interest in his life and under the circumstances the moving-picture producer should not profit by this renewal of public interest, especially since the producer had previously expressed the belief that the American public had lost interest in Lincoln.

The Court pointed out that historical facts such as the facts dealing with the life of Lincoln were in the public domain and were available to anyone. Since anyone had the right to use and refer to these facts the Court concluded that the production of a motion-picture play based upon the story of Abraham Lincoln's life did not constitute unfair competition.

In reaching its decision the court made the following statement:

"Countless decisions defining unfair competition preclude any favorable consideration for plaintiff's claim. Since the source of their material belongs to public domain, no exclusive right to the use thereof can be acquired even though they were the first to discover its value as a medium to awaken public interest."

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ESSENTIAL to defense against enemy aircraft are "listening posts" of the type shown on our front cover Set up on mobile trailer units, these ears of the Army are completely flexible, can be turned instantly in any direction to catch the faint hum of aircraft long before they come into visible range Data thus obtained are relayed to anti-aircraft batteries — Photo by Robert Yarnall Richie

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SCIENTIFIC AMERICAN

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NINETY-SIXTH YEAR • ORSON D. MUNN, Editor

AUGUST • 1940

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Our Point of View

IN NEW DRESS

WITH this issue, Scientific American opens a new period in its 96 years of publication Starting with a new cover design and modern, easier-to-read typography, we have evolved a new policy of editorial treatment that, we feel sure, will make Scientific American even more valuable to its readers than it has been in the past.

By segregating all editorial material into specific classifications, we are able to present a departmentalized magazine that permits the reader to turn immediately to those sections that hold the greatest interest to him and to find there the cream of the pertinent news Then, at leisure, he can survey the other sections, knowing that under certain headings he will find specific types of information.

Preview "dummies" of the new Scientific American, sent to hundreds of readers, have been enthusiastically received We hope that you will be equally pleased with the final and complete result In any event, the editors will appreciate your expression of opinion, whether it be in the form of a bouquet or a brick-bat —*O D M.*

ANTI-SABOTAGE

UPPERMOST in the thoughts of millions these days is the current problem of building up our national defenses Yet in all the billions of words that have been printed on the subject recently, little or no mention has been made of what should be our *first* and most determined step. Too much emphasis cannot be put on the need for an Intelligence Service expanded to the point of superiority, in numbers and brains, over that of any possible future enemy

We are a heterogeneous nation. Walking the streets past each of us every day are aliens, first generation descendants of aliens, and misguided "old Americans" who live under various delusions This is not to say that these categories are all inimical to our interests They aren't, some, indeed, even among the aliens, are better Americans than some sons of pioneers But the numbers of these and the freedom of speech permitted them in our democracy make it difficult to identify them until after they may have done their mischief And it must be remembered that "whispering campaigns" of propaganda can be a more serious form of sabotage than destruction of a powder factory or a power plant Such campaigns have already started in some sections of the country

Insidious work of foreign agents, with the connivance of residents, is going on under our noses constantly Nevertheless, we want no vigilantes, no civilian rumor-mongering or tattling on our neighbors It follows, then, that a vastly superior Intelligence Service should be organized and carefully trained. If this is not done, our national defense program will assuredly suffer all along the line from the work of numerous foreign agents now present in the United States —*F D. M*

A DRY-DOCK NEEDED

A NUMBER of things stand out in much of the current talk concerning the need for adequate national defense. One is the fact that we are now building battleships having a tonnage of 45,000 and may eventually go to larger sizes Another is the fact that New York City, because of its importance as a possible fleet base in time of war, and its excellent transportation facilities, should be equipped in every possible way to render it strategically efficient in case of war.

The shocking truth is that nowhere in the New York area is there a dry-dock capable of caring for our new 45,000-ton battleships There is none which could take care of our two largest aircraft carriers, the *Saratoga* and *Lexington* Yet in time of war these ships might be damaged near New York while defending the port They could not then put in at New York or be towed in for the necessary repairs before going into service again The New York Navy Yard dry-dock cannot take care of these ships, is 35 years old, and is up the East River behind bridges which might be bombed so as to block the exit completely Indeed, in time of war, continued operation of this Yard might hang precariously in the balance

The Port of New York Authority has recently urged the construction of a dry-dock of a size that would take not only our naval vessels but also the larger transatlantic liners Such a dock might be constructed at Jersey City, Weehawken, Bayonne, or Brooklyn, but certainly should not be up the East River into which bridges might fall after being bombed. To us, a project of this sort seems a vital part of our national defense program If that program is to be rounded out, the repair facilities afforded by adequate dry-docks in strategic positions are as necessary as the warships which will defend our shores The service of the fleet will be handicapped if such facilities are not prepared for their use.—*H. T. R*

HAVE SOME FUN

A PLAYGROUND exclusively for adults has met with great success in a recreational center near New York City. Here is equipment designed after that formerly used for children, but scaled up to meet the demands of grown-ups

And why shouldn't mature people hop around on pogo sticks, enjoy the thrills of a see-saw, experience the forgotten joys of a sliding board, pump on swings to their hearts' content, all in the privacy of their own playground and free from the prying eyes and competition of youngsters? Psychologists tell us that the way to keep young is to do young things, to forget the cares and worries of workaday life, to be kids again. The flexible minds that conceived the playground referred to have done their share to make this possible in one small part of the world Other municipalities will do well to copy.—*A P P*

50 Years Ago in . . .

SCIENTIFIC AMERICAN

(Condensed From Issues of August, 1890)

DEFENSE—"The exposed and comparatively defenseless condition of our most important seaboard cities, in respect to foreign naval attack, has for years been the subject for talk in Congress, but up to the present time little of a practical nature has been done in the line of protection It is true a few vessels of war have been ordered and some preliminary steps taken toward the manufacture of heavy guns for fortifications But in regard to the systematic and permanent defense and safety of such important harbors and cities as Portland, Boston, New York, we believe no definite plan has been fixed upon, no material steps as yet taken"

TUNNELING—"A tunnel to extend between Port Huron, Mich, on the American side, and Sarnia, on the Canadian side of the River St Clair is being bored by means of the Beach hydraulic shields The walls of the tunnel are constructed of cast iron segments, thirteen of which and a key form the circle The shield is the

invention of Mr Alfred E Beach, of the Scientific American It consists of a strong cylinder somewhat resembling a huge barrel with both heads removed The front end of the cylinder is sharpened, so as to have a cutting edge to enter the earth By means of a system of hydraulic jacks capable of either combined or separate action, it is possible to govern the direction of the tunneling shield with the utmost precision, making it to ascend or descend in the earth, according to grade required, or travel on a curve of any desired radius In the St Clair tunnel work, each shield is circular, 21 feet 7 inches in diameter, 16 feet long, and is built of plate steel one inch thick"

GOLD TEETH—"American dentists insert in American teeth, each year, the enormous amount of 800 kilogrammes (about 1,800 pounds) of the precious metal, which represents nearly $450,000 It appears that in less than one hundred years the American cemeteries will contain a larger amount of gold than now exists in France"

DEEP—"It has hitherto been upposed that the maximum depth of the Mediterranean was 10,785 feet, between Sicily and Sardinia Lieutenant Magnachi, of Italy, has found a depth of 13,550 feet, between Malta and Candia"

MILEAGE—"The following is given as the railway mileage at the beginning of 1889 Europe, 133,900; America, 190,000, Asia, 17,800, Africa, 5,200, Australia, 10,500, total, 357,400, as compared with 293,000 in 1884"

INDUSTRY MOVES—"The transfer of industries is one of the most strongly marked and distinctive features in modern industrial life. Its economic causes are to be found in the exhaustion of local supplies, the development of new areas, and the changing centers of commercial distribution The deportation of manufactures from the Eastern States to the West and South will largely change the old centers of wealth and industry These displacements may entail some local misfortune, and break up some time-honored establishments, but in a general and national sense the distribution of industries is an economic necessity and an industrial blessing"

TRAVEL HAZARDS—"Travelers on the Eastern Bengal Railway have placed before their eyes on entering the stations of the road a placard containing the following cheerful information 'Passengers are hereby cautioned against taking anything to eat or drink from unknown persons, as there are many who live by poisoning travelers When they reach a place convenient for the purpose, they poison the water or food of the passengers, who become insensible, and then they decamp with all their property'"

SPEED—"In a recent lecture before a scientific club, Professor Elihu Thomson declared that much higher speeds than can now be obtained with steam locomotives are to be expected by means of electricity, and he considered from 100 to even 150 miles an hour possible While in the steam locomotive there are reciprocating parts that must be put in motion, stopped, and reversed continually, in the electric locomotive we have simply a rotary motion, which makes it possible to run with economy at much higher rates of speed"

WORDS—'Eighteen words have come into the language —probably temporarily, most of them—to denote the act or state of electric killing They are as follows Electromort, thanelectrize, thanatelectrize, thanatelectrisis, elecrophon, electricise, electrotony, electrophony, electroctony, electroctasy, electricide, electropoenize, electrothenese, electroed, electrocution, fulmen, voltacuss, and electrostrike"

RABBITS—"A recent report by the United States consul at Sydney, N S W, gives a vivid idea of the extent of the [wild] rabbit pest in Australia The extraordinary fecundity of the animals under the climatic conditions have caused the country to be completely overrun . Vast regions are devastated, and the grass and other herbage is devoured The figure of five millions is given as the possible increase of two pairs of rabbits in three years Yet even this is a low estimate of the possibilities The average life of a rabbit is put at about nine years The doe may have young eight times in a year, averaging eight each time The first litter is produced when but four months old The progressions based on these figures lead to astonishing results"

ELECTRIC HEAT—"Electrically heated flat irons are now made which are very serviceable The flat iron is of the usual form, but made hollow The interior contains a lot of coiled wires, through which the electrical current passes and heats the wires hot The latter are arranged between protecting sheets of mica and asbestos You turn a switch, and the flat iron at once heats up ready for use."

STEEL CAVALRY OF MODERN WAR

A CHARGE of such modern tank cavalry, though a far less inspiring spectacle than a charge of regular cavalry, has a greater influence on the morale of the attacked In time, however, the psychological effect is lessened, though their greater "manpower," or striking power per man, is permanent Judging from present events in Europe, development of the inevitable successful counter to highly mechanized forces is still in the rather distant future. Whether this counter will be some new weapon or simply a sufficient number of opposing tanks, it is too early to say. However, it probably will be found in time.

96TH YEAR SCIENTIFIC AMERICAN AUGUST 1940

MACHINES FOR WAR

Organization and Operation of Mechanized Forces of Our Army

CAPTAIN J. E. McINERNEY
Ordnance Department, U S Army

MECHANIZATION, as it refers to war, may be truly defined as the adaptation of the best-known mechanical developments of the existing times to the weapons of war In recent years, the term has been restricted to the use of automotive vehicles for *combat* purposes This article will deal with this conception of the term, and will not touch on the subject of motorization which relates to the vehicles of the army that are adopted for general purposes, such as hauling cargo, ammunition, personnel, and equipment, and for towing guns, trailers, and other wheeled equipment

The development of combat vehicles carrying armament and providing protection for the crew has been a gradual one throughout the ages History is full of attempts to design devices to permit the soldier to approach the enemy under protection at a reasonably rapid rate and with all the fire-power possible

Naturally, the greatest advances were made in this type of equipment during the first World War The conditions of the war in 1916—that is, the use of the machine gun in conjunction with the trench and barbed-wire systems for defense—had so extensively increased the casualties of an attacking force that the war developed into a stalemate It was impossible to take the offensive without an enormous force and without considerable artillery preparation which eliminated the essentials of the success of the offensive—the elements of surprise and maneuver The employment of sufficient forces and their necessary equipment to conduct a successful offensive resulted in completely blocking most of the roads in any given sector to the extent of eliminating all freedom of maneuver.

It was soon discovered by the nations involved in the first World War that their resources of manpower were giving out faster than their munitions To increase their

MILITARY SCIENCE

fire-power and to conserve their supply of men became the goal It was realized that, with the conditions of the terrain as they existed after two years of war, a wheeled vehicle could not develop the required tactical mobility Two commercial inventions greatly assisted in solving the problem a track-laying device and the internal-combustion engine The track-laying device was first adapted to a combat vehicle, called a tank, in England in 1916 The name "tank" was used to keep the development as secret as possible With the development of the tank, armed and armored, the offensive was again restored, giving the attacker mobility, protection, and fire-power

We can get some idea of what our World War leaders thought of the effectiveness of mechanized units from the numbers of tanks which were on order in 1918 for the projected offensives of 1919

3 ton (Ford)	15,015
6 ton	4,440
Mark I	1,000
Mark VIII (Anglo-U S)	1,500
Mark VIII U S	1,450
Total	23,405

For our nation, mechanization has many distinct advantages As the most highly industrialized nation in the world it will give us, as a result of our great production facilities, a superiority which cannot be approached by the non-industrial nations An army which is mechanized will have on its side the necessary elements of surprise, maneuver, mobility, and fire-power, which are required for a quick and decisive victory. A nation not mechanized will have to fight a losing war or a long, costly, and inconclusive one with the resulting human, industrial, economic, and moral attrition.

It has been natural for us to follow, in a general way, foreign practices concerning the use and development of our mechanized units However, our geographical and economic conditions are such as to dictate characteristics for our army which might be entirely different from those of most other armies For example, the military tactics of a given country may have been dominated by the condition of its being hemmed in on all sides by potential enemies, requiring that they have fast mobile units which can be concentrated at any of its many frontiers on short notice These conditions, therefore, might lead to the neglected development of extra-heavy tanks, and tend toward the adoption of light, fast-moving vehicles

ANOTHER country, on the other hand, feels that her prime and foremost objective is to prevent an enemy from getting a foothold within her borders Hers is mainly a defensive attitude, and this is reflected in the type of vehicles which are developed for their mechanized units; that is, a medium tank, heavily armored, of relatively low speeds and no great cruising ranges This type is not as vulner-

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able to anti-tank weapons as the fast-moving vehicles

Our problem is more nearly similar to that of a nation having extensive colonies requiring types of light, armored cars which have great cruising ranges and can be used not only in actual combat in a major war, but also in settling domestic troubles throughout the entire domain When we consider that the theater of operations of the American army might cover the entire American continent it should be realized that our chief requirements are for light, high-speed, long-range, cruising vehicles

Although many foreign nations, were active in developing mechanized units immediately after the war, very little was done in this country until 1925 It is true that we did maintain a number of light and heavy tank organizations equipped with the slow-speed, wartime vehicles These units were mechanized infantry In 1925, a board of officers was convened in the War Department, and as a result of its study an experimental mechanized force was assembled at Fort George G Meade, Maryland, in the summer of 1928 Included in the equipment of this force were four light (7½ ton) tanks capable of a speed of 20 miles an hour, two cargo carriers with the same chassis as the light tanks, and two light and four medium, armored cars Most of the other equipment had been procured during or after the World War

An American medium tank. It is fast, well armed, and has good armor

THE results obtained with this experimental force were so encouraging that, in 1930, Congress appropriated funds to organize an actual mechanized force at Fort Eustis, Virginia This force totaled 640 men, and included therein were representatives from every branch of the service

In 1931, the War Department assigned a mechanized mission to the cavalry and directed that the mechanized force at Fort Eustis be demobilized and formed into a reinforced cavalry regiment This was in order to permit the cavalry to develop its organization and equipment for the performance of its normal cavalry missions Thus was born the mechanized cavalry

There is a definite need for two distinct types of mechanized forces The first should be highly mobile and capable of rapid advances so as to pass through enemy columns and to make flank or rear attacks These forces must be able to penetrate through thinly defended areas, or exploit a break-through made by the heavier fighting forces of infantry supported by infantry tanks, but cannot, because of their equipment, be required to deal with heavily defended positions The second type should be equipped in such a way as to break through heavily defended areas The first missions will be performed by the mechanized cavalry, and the second by the mechanized infantry

The War Department Directive of 1931 prescribed the mission of the mechanized cavalry as follows "Mechanized cavalry will be organized to fulfill the normal cavalry role, substituting the vehicle for the horse" This then requires that mechanized cavalry perform the following normal cavalry missions Offensive combat, long distance strategic reconnaissance, fighting for the theater of reconnaissance, seizing points of strategic importance, tactical reconnaissance, pursuit, delay of hostile advances, exploitation and taking advantage of break or weakened positions in hostile battle line, and attacking enemy rear installations

This War Department Directive did not in any way envision the complete elimination of horse regiments from our cavalry organization There are still many conditions, especially in the western hemisphere, under which the cavalry mission can be better accomplished by horse troops than by mechanized units.

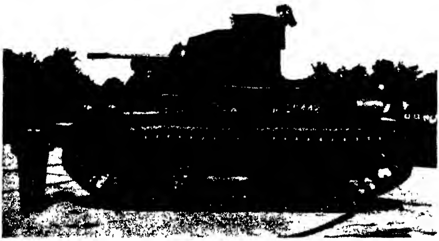
As a result of this Directive, the Seventh Cavalry Brigade Mechanized was developed at Fort Knox. It is composed of the following units 2 regiments of cavalry mechanized, 1 regiment of artillery, 1 brigade headquarters troop, 1 ordnance maintenance company, 1 quartermaster maintenance company, 1 squadron of observation aviation, 1 medical troop, and 1 engineers troop

It is planned to increase the mobility of the brigade by adding a reconnaissance and support squadron composed of a reconnaissance troop, machine gun troop, and a motorcycle troop In addition to acting as a brigade reconnaissance unit, this squadron will also serve as a minor reserve and a small arms, fire-support unit

In order to increase the fire power of the mechanized regiment, a third combat car squadron will be added to each regiment This will increase the number of combat cars in the brigade from 112 to 172

The cavalry regiment is the smallest organization with the equipment and means necessary to perform the four principal cavalry missions, namely

- *a* The reconnaissance troop mounted in scout cars equipped with caliber 50 and caliber 30 machine guns is charged with carrying out the necessary *reconnaissance* mission
- *b* The combat car squadron mounted in combat cars with caliber .50 and caliber 30 machine guns and with ample armor plate for protection are capable of exerting vigorous *striking blows*
- *c* *Small arms support* is furnished by machine gun troops



This light tank represents great improvement over its World War prototype

in scout cars

d A mortar platoon, mounted in vehicles somewhat similar to scout cars, firing smoke shells, provides for the *defense against hostile anti-tank weapons*

It is interesting to note that our largest mechanized unit is a brigade Most of the large foreign nations have complete mechanized divisions The Germans have the panzer division, the French, a light mechanized division, and the British, armored divisions

The mechanized cavalry will have their greatest opportunity of using their organizations to best advantage in open warfare However, in cases where the enemy has been able to establish himself temporarily in a strong defensive position, it will be necessary to use mechanized units capable of exerting greater shock than the highly mobile cavalry units This shock action will be delivered by the mechanized infantry

The infantry is charged with the principal mission in battle and is essentially the arm of close combat and can, through the employment of its own weapons, act independently of other arms

In order for the infantry to carry out its mission, it is furnished with tanks which are equipped with the proper armor, armament, and mobility As a general rule, tanks will function in close co-operation and co-ordination with the foot soldiers, either by preceding or accompanying the assaulting echelons. When operating directly in front of the attacking infantry, tanks are closely followed by the foot soldiers The visibility from tanks is naturally not the best, and defenders in many cases may be passed over by the attacking tanks Under the protection of the advancing tanks, the infantry can properly clean up the advance areas and then permit the tanks to penetrate into the rear areas

However, there will be cases when the defense is so thoroughly organized and equipped with anti-tank weapons that it will be necessary for a wave of heavy, armored and armed, relatively slow-speed tanks to precede the lighter and more mobile tanks The former tanks are referred to as leading tanks, whereas the lighter tanks are classed as accompanying tanks Leading tanks may operate in support of infantry regiments, or they may be attached to the regiment When operating entirely within a regimental zone it is preferable to have leading tanks attached to the regiment

Accompanying tanks are assigned to divisions and then may be attached separately to different units as small as a battalion Our tank organizations are made up of tank regiments and separate divisional tank companies Practically all the divisional companies are part of National Guard organizations, whereas the Regular Army units are tank regiments

Light and medium tank regiments are practically the same in organization, with the latter having a slightly greater number of personnel Both are composed of three battalions of three companies each, and the company in turn consists of three platoons This represents the triangular type organization. Within each regiment there are 162 tanks, of which 135 are combat tanks, and 27 are command and staff tanks

It is interesting to note that since the war started the French regimental tank organization has disappeared and the tank battalion is now the tactical and administrative unit Outside of the mechanized division, tank battalions are assigned to GHQ Reserve or to the Army

As the first requirement in allocating tanks is to furnish sufficient support to overcome any resistance that might be encountered and still have sufficient reserve strength to push on to further objectives, tanks should be used in relatively large numbers The tank company may operate separately, but the tank platoon never does

In deciding on the use of tanks, it is essential to give careful consideration to the nature of the terrain In making a study of this problem, all possible information should be obtained from maps, aerial photographs, and by ground and air reconnaissance Natural obstacles to tanks are rivers and streams which cannot be forded, marshes, fordable streams with steep banks, thickly wooded areas with large trees, and areas with closely spaced boulders In open, rolling country, where excellent fields of fire are available to the defenders, the effectiveness of tanks is greatly limited

SOME idea of the importance of proper reconnaissance may be obtained from the recommendation of Major General Walter C Short, Commanding General of the Fourth Corps Area in discussing the lessons learned from the Corps exercises at Fort Benning That recommendation was that a troop of mechanized cavalry be added to each of the streamlined divisions, the troop to have three platoons—one to be assigned to each of the combat teams of artillery and infantry for reconnaissance purposes

In addition to a study of the terrain to determine the natural obstacles, it is essential that careful measures be taken to determine what obstacles have been set up by the defenders Anti-tank weapons will be numerous in any case where the defenders have a day or two to become organized Whether the guns will always be of the caliber to defeat the armor of the tanks might be questioned As the armor plate of tanks gets heavier, there

will be a requirement for weapons of greater muzzle velocity maintaining the same mobility for the gun, or less mobile guns of larger caliber The race between armor plate and the gun has been going on for years In naval history it is believed that the gun has won out In tank history there are enough different factors that influence the results that we may expect a different answer

The following extract from an article by Major O F. Marston in the January-February issue of *Field Artillery Journal* may be of interest In speaking about anti-tank defense he remarked "What results have been accomplished? At least the field artillery feels that, where indirect laying is used, covering zones and areas where zone fire is used on assembled tanks or other mechanized vehicles, the problem has been solved However, where direct laying is employed, even the most optimistic are not agreed that a solution has been found; and the faster the tank moves the fewer there are who are in agreement on a solution to this vital problem After talking with many officers and men, and after having had considerable experience with the problem for several years, and with the latest equipment now in the hands of our troops, the writer is of the opinion that the problem is far from solution "

There is no commercial demand for the types of vehicles which are required by our combat arms. The requirements of high speed for strategic mobility and for cross-country tactical mobility are such as to require specially designed vehicles In designing these special-purpose vehicles, it is the policy of the Ordnance Department to use, as much as possible, commercially available units, such as engines, transmissions, and the like. In most of our combat vehicles, the weight and space factors of the power train units are of paramount importance. As much as possible of the total weight of the vehicle should be devoted to armor plate Also, sufficient space must be provided in the fighting compartment for the efficient servicing of weapons, for the comfort and convenience of the crew, and for carrying ammunition, guns, radios, and other impedimenta

THE lighter, high-speed, full track-laying vehicle used in our service is over ten tons In order to get the required performance in our combat vehicles, it is necessary to have a power/weight ratio of not less than 25 horsepower per ton weight of vehicle Commercially available engines in the automotive industry are not made with horsepower greater than about 165. Rather than design a special engine, which is an exceedingly long and expensive undertaking, the Ordnance Department has adopted commercially available engines from other fields for use in most of our combat vehicles.

Knowing the many advantages of the Diesel engine, such as reduced fire hazard, increased cruising range, absence of radio interference, and so forth, the Ordnance Department has not neglected the development of this type of engine A number of Diesel engines giving the required performance for our combat vehicles have been procured This type of engine is particularly well adapted for use in cavalry combat vehicles because of the increased cruising range—is almost double that of gasoline engine vehicles of approximately the same weight

Of the full track-laying type of combat vehicles, our army is equipped with combat cars, light tanks, and medium tanks We have experimented with convertible, or two-purpose, types of tanks and combat cars The convertible type of vehicle is popularly known as the Christie type, named after Mr J W. Christie, an inventor who sold a number of experimental vehicles to the War Department

Ready for action in Army maneuvers: tanks and scout and combat cars of 13th Cavalry Mechanized

In modern warfare, tanks and planes operate in co-ordination

From an engineering point of view, it is almost axiomatic that a convertible vehicle will weigh more than a single-purpose machine of the same performance and characteristics It may be noted that none of the major powers except Russia have produced convertible tanks

The light tank used by the infantry and the combat car with which the mechanized cavalry are equipped are similar in many respects The engine, power transmission system (except the ratio of the final drive), the cooling system, steering and control systems, fuel and oil systems, and the electrical system are common to both The chief difference is the thickness of the armor and the amount of armament The combat car used by the cavalry has a requirement for a higher speed and less armor than the tank.

Tanks in the weight class above 12 tons and less than about 35 tons are considered medium tanks The medium tanks used by our service have ranged in weight from about 15 tons to 20 tons The French army is equipped with a number of medium tanks of about 35 tons in which are installed 75mm cannon.

Our army has not been furnished any heavy tanks since the World War when the Mark VIII tank, weighing about 40 tons, was developed.

In addition to the full track-laying type of vehicle, there is a demand for half-track and wheeled vehicles The half-track trucks and cars are part of the equipment of the mechanized cavalry and are used by the artillery attached to the mechanized unit as prime movers for light guns and for hauling ammunition The wheeled vehicles are scout cars, also used by the mechanized cavalry, for machine gun and reconnaissance troops The scout cars are four-wheel-drive vehicles equipped with armor and armament and have fairly good cross-country mobility and are capable of speeds on main roads of over 50 miles per hour

The recent events in the present war have clearly indicated that the old axiom, "Getting there fustest with the mostest men" still applies, but the tempo of all warfare has been greatly accelerated However, it has also been shown that, "He that has mostest (mechanized vehicles) fustest will get there fastest " The machine has not entirely replaced the man in modern war, but a nation that is not industrially prepared for war is doomed to an uncertain fate, to say the least!

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TANKS

United States Deficient in Combat Vehicles

THE present war in Europe has shown the military effectiveness of large numbers of combat vehicles of several types, but the United States is sadly deficient in this arm of the service. In recent hearings before the Senate Committee on Appropriations, the following figures were given to show the strength of our mechanized forces

	On hand May 1, 1940	Will be on hand upon completion of program
Light tanks, M2A4	10	734
Medium tanks M2	18	194
Scout cars	466	1346
Combat cars (Infantry tanks)	114	308

These figures consider only the very latest models We do have several hundred light tanks of earlier design but it is believed that these would have very little use except in training.

LARGER CRUISERS

New Type, Heavily Armed and Armored, Suggested

IT TAKES from three to five years, depending on urgency, to build one battleship in an American yard In times of national peril, more effort is expended on construction of a larger number of small warships

Under construction and planned for the United States Fleet at present are 10 battleships Only two of these, however—the *Washington* and the *North Carolina*—have been launched, and each of these two will require more than a year to finish Completion of the others is proportionately far in the future Due to this situation, coupled with the war in Europe, it has been suggested that the United States build for the Atlantic a number of large cruisers of 20,000 to 28,000 tons This would be an entirely new type of warship—fast, armed with 11-inch guns, and well armored against air bombs It is believed that these ships will constitute a more efficient type for operation in coastal waters than our battleships but will be far more powerful than any present cruisers or the over-sized, fast destroyers which may be built to support them

Whether these new ships will be of the size indicated above or something smaller, Chairman Vinson of the House Naval Committee declares that their construction will not disturb the present building program

Incidentally, that program probably will be greatly enlarged in the near future, perhaps before this issue is published As we go to press, Congress is considering a plan to increase our Navy by 70 percent, giving us, by great odds, the most powerful navy in the world. If details are made available, we will publish them later

Achievements in Textiles

Commonplace Fabrics with Superior Characteristics Given by Special Treatments

PHILIP H. SMITH

When it becomes possible to remove shoe polish, inks, fruit juices, and cocktails from delicate silks and cottons by merely dunking them in a glass of water, you've got something When a fabric so treated is immediately spot free and dry, you have, to be exact, a marvel of chemistry, not to mention a boon to housewives

Brilliant achievement in the improvement of commonplace textiles has been all but obscured by the more sensational creation of synthetic fibers out of air, coal, and water, or from cow's milk But there are now on the market cottons, rayons, and silks which repel water and resist spotting There are fabrics which resist creasing to maintain their freshness for a long period of time, and there are woolens which won't shrink and are distasteful to moths If fire-retardent finishes are desired on textiles, they can be had, and so can finishes which are unaffected by mildew, a serious problem at all times but especially so in damp climates

The threat of synthetic competition can hardly be credited with all the progress in textile finishes Research has been seeking a way to impart these several desirable properties for many years and success is the logical fruit of cumulative effort

The public is beginning to learn of water-repellency but there is still confusion in some minds as to the difference between repellency and water-proofing They are quite unlike The former describes a treatment whereby fibers are rendered proof to water while the fabric remains porous, the latter calls for making the entire fabric surface impervious to water Water-proofing is a much older art

There are two common ways to obtain a water-repellent finish One is to use a soap bath followed by alum or an aluminum salt to deposit an aluminum soap on the fabric The other is to apply an aluminum or lead soap from an organic solvent There is a more recent process wherein a wax emulsion in water is applied to a fabric in a single bath These finishes were used first for outerwear garments, but varied applications have been made, realizing that repellency means freedom from water-spotting, because a water spot is nothing more than a local contraction of fibers which alters light reflection

By applying water-repellent finishes to hosiery they can be made virtually splash-proof Dirt is prevented from penetrating the fibers, so that a gentle washing or dusting will remove it Snag-proof finishes for hosiery are usually wax emulsions which lubricate the surface to resist abrasion, but resin finishes are coming into use

All of the foregoing processes leave something to be desired because they are impermanent It is true that they lengthen time between cleanings and so increase fabric life, and repellency can be restored by incorporating products in the cleaning process, but this is troublesome Today, permanency is a reality

One manufacturer has developed a process which will survive about 10 cleanings and he does a mail-order business in reviving repellency for a nominal sum There is also a single chemical compound available which can be applied in four steps—impregnation, drying, heating, and rinsing—to render cotton, rayon, and silk durably repellent and do almost as good a job with acetate rayons and wool fabrics The compound must be applied during the finishing process as it requires good equipment, but it is not a resin as one might suppose

There is practically no limit to the application of this water-repellent product It is now being applied to sport clothes, shower curtains, and outdoor furniture, often to replace waterproof materials Because it leaves fabrics porous, it serves very well to treat undergarments, and the fact that it makes pressing less imperative promises its wide use for men's suits Hence it may have wide application

The synthetic resins have been seized upon by the textile industry and are being given quite a wide play One of the first applications to come to the attention of the consumer was the "fused" shirt collar which won't wilt This now widely used product is made by sandwiching cellulose acetate or other thermoplastic resin between layers of fabric Resins also are used to prevent slippage of yarn in woven materials so that garments won't lose their shape, to bind colored pigments in printed fabrics, and to give a glazed effect to textile surfaces

Different types of resins are used to achieve special effects Thus the methacrylate type can be used to give fabrics a "handle" which resists laundering and dry cleaning It is also employed as a yarn size for viscose and acetate warps and for filling yarns of crepe fabrics, because it is easily removed and does not encourage bacterial growth as do casein, glues, and gelatine Vinyl resins were the subject of a recent announcement to the effect that they serve excellently for water-proofing and moth-proofing with all kinds of fabrics, but this development is still young

Crisp organdy apron that is water-repellent, permanently starchless

Crease-resistance, or crush-proofing as it is sometimes called, is a quality now imparted to cotton, rayon, and linen as an outcome of English experiments with urea-formaldehyde resins. Here the problem to solve was one of getting the resin inside the cellulosic material of the individual fibers, because an outside coating only produces a stiff and brittle cloth. The process requires impregnation of the cloth in a bath of resin components, urea and formaldehyde, with a catalyst, or a lightly condensed mixture, provided the condensation permits complete penetration. The fabric is then passed through a mangle to remove all excess liquid, and dried. After drying, it is heated to a high temperature to bring about polymerization, or the creation of large molecules from small ones. Then such chemicals as have not been rendered insoluble can be removed by washing.

Satin becomes practical for sportswear when treated with water-repelling chemicals, as in this ski-jacket

Urea-formaldehyde resins have the capacity to alter the life and draping qualities of fabrics, to increase the fastness to fugitive colors, and to reduce shrinkage in washing. Rayons treated with them are given greater strength, particularly in the wet state.

The use of resins by the textile industry is still in its infancy, but for that matter, the resin industry has yet to mature. With approximately 150 different resins on the market and more being born by the minute, it requires much research to determine the benefits to be derived from any single one, or to select the best. Application of resins to fabrics increases their cost slightly and the textile industry is loath to add to cloth prices until the public demands certain properties and is willing to pay for them. Furthermore, an industry as old and as highly specialized as the textile industry is slow to adopt the new, but there is enough stirring right now to promise a wide use of resinous products.

During the past two decades a great deal of research went into development of fire-retardent finishes, but, one and all, the products had some practical disadvantage. The latest and most satisfactory process seems to be one employing ammonium sulfamate. It is claimed not to dust off, nor to alter the feel, appearance, and durability of fabrics. It will withstand ordinary dry cleaning, but not laundering.

Research to attack the problem of mildew and moths has been quite successful and both can mean the saving of millions of dollars resulting from cloth destruction. The most satisfactory agent for mildew control has been found to be salicylanilide. Customary practice is to impregnate the cloth with the chemical from an ammoniacal solution, and then dry it. With the evaporation of the ammonia, the insoluble agent is left dispersed throughout the fibers and threads. Among the several chemicals developed for moth-proofing, the best appear to be organic and inorganic compounds of fluorine or chlorine.

THE conquering of cotton shrinkage is too well known to warrant detailed mention here. It is enough to say that the mechanical process known as Sanforizing gives adequate control over what was once a knotty problem to the textile producer and a terrible nuisance to the consumer. More and more cottons are being pre-shrunk with this process and in time all cottons may be shrunk before sale. Installation of shrinking equipment has been taking place in mills all during the depression to satisfy consumer demand.

The shrinkage of wool has long been studied to devise some means for arresting it to make a more serviceable fiber. A solution to the problem seems to have been reached at last and perhaps the best evidence of success is the statement that all woolen socks distributed to the fighting forces of Britain are to be given the new treatment. Before discussing the process, however, it will help if we outline the phenomenon of shrinking.

Photos Du Pont Style News Service

Rayon velvet, made crush-resistant for practical wear

The individual wool fiber appears to be covered with countless small, overlapping scales which are responsible for the interlocking of the fibers, and, incidentally, for the property of felting which is utilized to make felt hats. When wool is compressed in washing, the fibers

Water-repellency at last makes an improvement in men's coats

Liquids which ordinarily stain are not absorbed by fibers of material which has been made water-repellent. In the tests shown in these photographs, ink was flushed off with clear water

become more and more entangled and close together more tightly, the process being repeated with every washing. Stripping the scales from the fiber will make wool unshrinkable but at the same time it shortens fiber life because they lose their protective covering. If a compromise is sought by removing scales only partially, there is a corresponding loss in shrink-proofing and this falls short of the goal

The new process calls for applying sulfuryl chloride to the wool with the following claims as to action and benefits The scales are not substantially removed but rather, their projecting ends are probably made to hold more closely to the fibers so that they are smooth and lose their felting propensities It is also claimed that the fibers are uninjured

Other processes developed to retard wool shrinkage are those using dry chlorine gas, and certain of the alkyl hypochlorites But the claim for these agents is not as strong as those for sulfuryl chloride

It is very evident that research work has been directed toward the improvement of old processes quite as much as to the origination of new ones Water-repellency and crush-proofing, for example, are not brand new, but older processes were impermanent in effect Once a fabric had passed into consumers' hands and had undergone its first cleaning, the bloom was off and there was little to warrant paying for so brief a pleasure The most recent developments contribute a lasting quality value to fabrics and this represents a long stride ahead

A still further step remains to be taken, however At the moment, the use of one process pretty much excludes the use of another. The new permanent water-repellency process can be used in conjunction with urea-formaldehyde resins to make a fabric having two imparted qualities, but for the most part processes are mutually exclusive and that limits the number of advantages given to any single fabric

For just about a century, people have been pondering the idea of printing fabrics in the manner of printing paper so that the color is applied direct, rather than to continue with the laborious process of printing with dyes which emerge as color only after a series of chemical treatments To get a pigment that will strike into the fabric and make a permanent bond without spreading, that will be light-fast and wash, has eluded searchers for many generations Such colors are now available—a lacquer type and a resin type They are incorporated with pigments; and after printing, a drying process develops them These new types of color are being used to print shirt materials in very large volume and the benefits are primarily those of eliminating developing processes to gain production speed

There is hardly a phase of the highly specialized process of textile production which has not been touched beneficially by research Most achievements thus far have small interest to the consumer because the only evidence of benefit is in the overall sense of obtaining better quality and better designed fabrics at somewhat lower cost. But the end is not in sight Research came to the textile industry much later than to others and what we enjoy now is only a beginning.

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Metal from the Sea

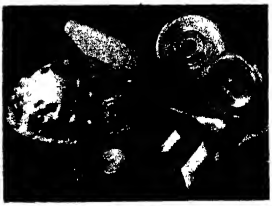
Plant Will Extract Light-Weight Industrial Metal, Magnesium, From Solution

For centuries, adventurous men have roamed the seas exploring the hidden depths for the wealth of sunken treasure Little success has been theirs Yet long before man even appeared upon the earth the sea was storing up treasures of a different kind—valuable chemicals and metals dissolved from the land by flowing water.

Some years ago a large plant was placed in operation at Wilmington, North Carolina, to extract some of this wealth-in-solution in the form of bromine to be used in preparation of anti-knock gasoline. Now the same company responsible for that plant is building another to extract the metal magnesium from the sea. This new plant, according

At left: Typical sea water intake which will conduct water to settling basins, the first step in production of magnesium from the sea

Below: Extruding an alloy of magnesium. It can also be die cast, sand cast, forged, and welded. At right: Airplane propeller blade and other aviation parts made of Dowmetal, world's lightest, strong structural metal



to a recent announcement by Dr Willard H Dow, President of The Dow Chemical Company, sole producers of magnesium metal in America, will be located along the Gulf of Mexico At that point enough of the metal will be extracted from sea water to raise Dow's total magnesium production from 12,000,000 to over 25,000,000 pounds annually

The growth of the infant magnesium industry in America has been amazing, considering that it had its birth in 1915—only 25 years ago For that growth a great share of the credit goes to the founder of the company bearing his name, Dr. Herbert H. Dow

The growth and development is significant because magnesium, third most abundant engineering metal in the earth's crust, is an important constituent of modern light-weight alloys which are being used more and more widely in aviation, bus, railroad, and general transportation industries as well as in the manufacture of light-weight tools and many other products. The reason for this wide use is that Dowmetal, a silvery alloy, is one quarter the weight of iron, only two thirds as heavy as aluminum, and is possessed of great strength, toughness, and durability. It is speedily fabricated by all common methods.

Each one of the oceans' 320,000,000 cubic miles of water contains something like 175,000,000 tons of chemical combinations of such materials as gold, silver, copper, magnesium, aluminum, calcium, bromine, iodine, and other valuable elements. It has been estimated that these materials in each cubic mile of water have a value of some five billion dollars if only they could be extracted Bromine *is* being extracted and shortly the recapture of magnesium will begin near Freeport, Texas

Up to now magnesium has been produced at Midland, Michigan, where the raw materials, from which the metal is extracted, is taken from the ground Chemists say that it can be recovered from sea water with less effort than from the land because of the fact that the water has already done the preliminary job of washing the magnesium out of the soil

The new plant will have a capacity of 12,000,000 gallons of sea water daily, yet that plant can operate for 300 years extracting the magnesium in just one cubic mile of ocean water In that same cubic mile—it is actually more than 1049 billion gallons—there are about 5,700,000 tons of magnesium.

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BOND

Process Binds Rubber to Aluminum

DURA-BOND is a new process developed by Hewitt Rubber Corporation for bonding rubber or neoprene to aluminum, according to the *Aluminum News-Letter* Adhesive strengths up to 750 pounds per square inch can be obtained, but the process should be restricted to products which operate at temperatures below 200 degrees, Fahrenheit

This new process makes use of a chemical coating between the rubber and the aluminum which fuses the two materials together without diminishing the ability of the outer layers of rubber to be vulcanized The metal needs no coating of hard rubber to make the soft rubber take hold, and brass plating of the metal is unnecessary

Combinations of rubber and aluminum have wide application in the manufacture of sound-proofing equipment for machinery, in the production of spark-proof oil-suction hoses and fittings, and in pickling bath apparatus

PORCELAIN-LIKE

Coatings Are Hard, Mar-proof, Resistant to Acids, Alkalis

TWO new porcelain-like finishes have been developed by Toch Brothers Division of Standard

Varnish Works Known as Kwickdry and Rockloid, both these finishes are hard and mar-proof, will not chip, flake, or crack Yet they have remarkable flexibility and light, heat, and chemical resistance. Mild alkalis and acids do not affect them They are resistant to most solvents and possess excellent humidity resistance.

The first of these two finishes, Kwickdry, is satisfactory for outdoor and indoor use It may be used as a one coat system or over a primer, sprayed or brushed It sets tack-free in 10 to 15 minutes and dries hard in one to two hours, or may be force dried at 140 degrees, Fahrenheit, for 20 to 30 minutes

The second, Rockloid, is intended primarily for indoor coatings It may be applied as a one coat system and baked at 350 degrees, Fahrenheit, for 10 minutes, or at a lower heat for a longer time

STEAM CONTROL

Spinning Disk Prevents

Valve Clogging

A NEW principle of steam control is incorporated in the Ostlind valve, which was announced recently The valve is the invention of Joel Ostlind The principle is said to eliminate the causes of leaky valves, rather than to resist them

The Ostlind innovation is a spinning disk, which rotates up to 2000

Pencil points to turbine vanes

revolutions per minute for a moment preceding closing The disk does not spin when the valve is "cracked," or while throttling A reversing chamber directs the steam flow to turbine vanes just before the disk descends into the seat The turbine vanes are shielded from the steam flow when the valve is open

The spinning disk throws off scale and other foreign particles by centrifugal force, thereby preventing these particles from becoming caught in the line of seating. The disk hits the seat while spinning at a high rate of speed, and polishes the line of closure, creating a complete metal-to-metal contact between seat and disk, thus preventing "wire-drawing"

The disk is mounted on the spindle against a stainless-steel ball bearing, aligning the disk with the seat when closing

BETTER COPPER

Made by Plastic Conversion

Under High Pressure

ANNOUNCEMENT of the perfection of a new type of copper after a ten year research and development program costing well into seven figures was made recently by Wylie Brown, President of the Phelps Dodge Copper Products Corporation

The new copper is known as "PDCP," and was created by research to meet the need of the elec-

Ductility and smoothness of PDCP shown by rupture test

trical industry for a copper of superior characteristics Greater conductivity, ductility, fatigue resistance, and surface quality are the outstanding characteristics of this modernized metal It is free of the imperfections of ordinary copper, which, according to engineers, have been responsible for a large percentage of electrical failures

The improved metal is made, without melting, from electrolytic cathode copper which is plastically converted by tremendous pressure in a reducing atmosphere at elevated temperature, into smooth, dense copper bar, rod, strip, or other desired commercial shapes Basically of the oxygen-free type, it is the only solid copper in the world which is not melted subsequent to the electrolytic purification process Hence, the intrinsic purity of electrolytic cathode copper is retained and enhanced

One of the principal difficulties of engineers and maintenance men concerned with copper windings in motors and transformers, is the existence of surface imperfections in the copper which, by vibration and magnetic stress, eventually penetrates the insulation and causes failure by short circuits. These imperfections may originate in defects arising in the casting process and are normally present in the best commercial copper wire bars In addition, slivers and oxides are developed during the process of

Twisting rod of new copper to destruction required 30 twists

hot-rolling the cast copper bars into rods, and are more or less inherent in the hot-rolling process The new patented method eliminates not only the casting process, but also hot-rolling It has, in consequence, made possible the production of a sliverless and dustless copper surface heretofore attainable only in the laboratory

PDCP copper, in common with all other coppers, is not susceptible to heat-treatment in the sense that the ferrous people use the term it can be hardened by cold work, softened by annealing It does, however, anneal at a temperature between 100 and 200 degrees, Fahrenheit, lower than other coppers In fact, protracted tests have shown that it will anneal slowly in boiling water at 212 degrees, Fahrenheit

BY-PRODUCTS

Citrus Fruits Find

Uses in Industry

A CONSIDERABLE amount of research has been conducted on the problem of finding a use for citrus fruit surpluses and wastes As a result, many new products have been developed, among which are the wines and liquors announced in these pages some months ago, which were developed by the Bureau of the Department of Agriculture Also, new and better types of citrus-fruit juices and oils have been developed These by-products have found a ready market in industry, medicine, and agriculture

Citrus juices are popular in the beverage and dairy industries Citric acid from lemons, another best-seller by-product, competes

with Italian imports for use in beverages, lemon and orange oils for bakery goods, candy, and flavoring

Sodium citrate is used by the dairy industry Citrus pectin, from the white pulp of citrus fruits, adds creaminess to malted milks and soft drinks Pectin has been found valuable, too, as a blood coagulant and as a stabilizer for the barium sulfate used in digestive X-ray work and as a detoxication agent Pectates, close cousin to pectin chemically, have application in paper-treating, in rubber production (for creaming latex), and in quenching steel more cheaply

Soon to appear is a new vitamin, Vitamin P (citrin), prepared from lemon and orange derivatives, now being submitted for clinical use "Squeal-of-the-pig" is citrus meal, made from the dried peel and pulp, fed to dairy and beef cattle, poultry, sheep, rabbits, and goats

MACHINE CLUTCH

For Cone-Driven Machines Makes Speed Change Easy

FOUR-SPEED transmissions for application to cone-driven machine tools are announced by the Western Manufacturing Company They make changing from one speed to another as easy as when driving an automobile There are three models—a "Master" for 1 to 5 horsepower, a "Major" for 5 to 10 horsepower, and a "Super" built to specification for machines requiring larger than 10 horsepower motors It is built for heavy loads with the transmission case and covers of semi-steel castings and the gears and spline shafts of alloy steel, machined to close limits and ground All of the moving parts run in an oil bath.

Four speeds

BALANCE

A LOW-PRICED, compact balance, that can be readily dismounted and stored in a laboratory drawer is announced by the Clay-Adams Company This instrument has been designed to meet the needs of all balance technique, and at a price within the reach of the student in chemistry It is supplied with brass weights.

In use, the upright beam support is inserted into a metal socket in the box and the beam placed upon it An eccentric beam release brings the pans to rest Capacity is 100 grams; sensitivity 5 milligrams, beam, 7 25 inches long with steel knife edge, support for beam is an agate bearing Pans are 3 25 inches in diameter, and are notched to support test tubes

SOLDERING

STAINLESS steel, beryllium alloys, brass, copper, bronze, and other metals may be easily soldered when Geko Acid-Free Soldering Compound is used This is a new product developed by Geko Chemical Company

Geko is free of any mineral acid and is therefore non-corrosive if used according to directions It makes the first cleaning of the metal unnecessary for it creates a perfect and lasting bond even on oxidized surfaces It may be used with soldering iron, open flame, or even a match, as its melting point is quickly reached

LINKED PLASTICS

Ingenious Method for Molding Plastic Chains

WELDLESS chains of Tenite are an outstanding accomplishment in the art of plastic molding They are the first plastic chains of this type, and were made possible by the molding properties of Tenite combined with an ingenious mold design

The chains are shown in our illustration in both cast and finished forms The mold design automatically eliminates any cutting, threading, and cementing of the links—operations that are necessary in making the more common welded plastic chains Severing the links from the runners of the casting is the only finishing required

Chain as cast and as finished

AUTOMATIC

Carbon Arc Process Makes Better Weld, Saves Time

AUTOMATIC carbon arc welding is reported to have many advantages in the construction of aluminum tank cars at the American Car and Foundry Company plant at Milton, Pennsylvania The automatic process permits faster construction and a considerably better quality weld, together with marked freedom from distortion This development was motivated by a desire to improve quality, not to lower costs which are practically unchanged because the increased flux cost cancels the labor saving

Since no beveling of plate edges is required, the full thickness of metal is utilized in the welding by simply butting the square edges together, greatly simplifying the set-up of the work The welding time per tank is noticeably shorter than previous methods since the automatic weld is made in two passes instead of the three formerly used. The fact that automatic welding permits welds of complete overlapping penetration accounts for the greatly improved quality of the weld The aluminum tanks manufactured by the American Car and Foundry Company have, for the most part, been utilized for glacial acetic acid service. This

is the basic material for the manufacture of rayon and non-inflammable film. Two of the aluminum tanks have also been put into service for carrying peroxide These were constructed of 2-S (99 5 percent aluminum). The remainder of the tanks, for acetic acid service, were constructed of 3-S aluminum (97 5 percent aluminum).

RING

Comparison Tests of Metals Under Heat

A bell made of ordinary materials gives off a dull thud when struck after being heated to a high temperature A new metal, called K-

Test by ring

42-B, developed in the Westinghouse Research Laboratories, gives off a brilliant tone under the same circumstances This new metal is therefore being used for comparison tests of metals

In our accompanying illustration a bell made of steel is shown at the left while one made of the new metal is at the right, both having been heated to a high temperature While still very hot, the steel bell at the left gives off a dull thud because of the inelastic movement of its atoms which converts the energy of its vibrations into additional heat

TESTING WELDS

Magnetic Dust Reveals Tiny Cracks

Cracks which tend to develop during cooling of a welded joint can be dangerous even though extremely small, since large stresses that are set up in the vicinity of the flaw lead to the extension of the crack in the metal. One of the successful non-destructive means of testing welds for flaws is the magnetic method. Under suitable conditions very fine surface and subsurface flaws as small as 1 by 10^{-5} centimeters can be detected by this method

The principle of the method depends upon the fact that the presence of a fault in a magnetized specimen will cause distortion of the magnetic field on the surface of the specimen. The magnetic susceptibility of the fault is much lower than that of the sound metal, and the flaw acts as an air-gap, the magnetic flux at this point being diverted into the surrounding material The leakage field at the flaw can be more strongly detected the nearer the flaw is to the surface The greatest depth at which flaws can be detected is about 0 5 of an inch.

Best results are obtained with a direct current magnetizing field where the flux passes through the flaw at as near 90 degrees as possible The type of metal used will determine whether or not the magnetizing current can be turned off while testing the weld. The detection of flaws in the weld is accomplished by means of fine iron dust which is applied to the surface of the magnetized specimen. These particles will then move to a point where there is a large leakage field or a flaw The dust may either be blown or sifted onto the specimen, or suspended in a suitable light oil which is poured or sprayed onto the specimen The smoother the surface tested, the more clearly will cracks be shown —*H Hirst*, The Commonwealth Engineer *and* Highway Research Abstracts

CORES

Wetting Agent Reduces Machining of Castings

Non-ferrous metals can now be cast in smooth, fine cores at a considerable saving in time. This is accomplished by the addition of a small percentage of Sulfatate, a new type of wetting agent manufactured by Glyco Products Company, Inc.

The ordinary core for casting non-ferrous metals is usually a combination of silica, sand-clay binder, and linseed oil. This type of core is very rough and necessitates a great deal of machining to finish the casting. If after baking the core, it is dipped into a solution consisting of one pint of molasses, 10 pounds of graphite, one pound of Sulfatate, and water sufficient to make five gallons, and then re-baked, the core will present a smooth surface, and the casting made from it will require little if any machining.

The addition of the Sulfatate eliminates the necessity of hanging the core so that the excess molasses-graphite mixture will drip off The core, when it is withdrawn from the solution, breaks cleanly.

CUTTING

Cemented Carbide Tools Now Standardized

Probably every user of cutting tools has looked forward to the time when he could enjoy the many recognized advantages of cemented carbide tools without the necessity of a large investment in special tools Although the longer service life of cemented carbide tools has proved that they do actually "lower the cost per piece," yet the

Bonded edges of cemented carbide in a standard tool

necessarily higher price of specially-made tools has limited their use on short jobs and general tool room work

Announcement has been made by the Wesson Company of a complete line of standard carbide cutting tools At present, these standard cemented carbide tools include reamers, shell reamers, core drills, end mills, counterbores, and inserted blade milling cutters. They are produced by a process which has involved the development of a new treatment for shanks and bodies. An important feature is hardening at temperatures which do not injure the bond or the carbide insert.

FLUORESCENCE

THE New York World's Fair offers a great spectacle of illumination, but, more than that, it has been a proving ground for new and improved lighting equipment. If full advantage were taken of the new light sources available and the general level of illumination were to be raised to adequate heights, lighting would be revolutionized.

Take just one item—the fluorescent lamp Here is an efficient and practical source of daylight lighting Invisible ultra-violet energy, produced by an arc, is converted into visible light through the medium of fluorescent powders lining the tubes Older practice was to coat incandescent bulbs to strain out all unwanted rays, and this was inefficient The new lamp produces about 40 lumens per watt, the household filament only 15 lumens

Being unexcelled for color discrimination, the fluorescent lamp is used for matching leaf tobaccos, inspection and pairing of hosiery, and inspection of color proofs Because powders can be selected to give different colors, progressive merchandisers have a new field for color utilization at their disposal The lamp radiates only one fourth as much heat as an incandescent lamp, hence it has special value for the food industries and for show-case lighting of perishables

The fluorescent lamp is a special purpose light, not a substitute Many units are needed for high levels of illumination, despite the high lumens per watt, because the lamp is a low-wattage type Equipment and installation costs are higher than for ordinary lighting, but an expanding use is bringing these costs down

INFRA-RED DRYING

Not to be credited to any Fair is the infra-red drying lamp, now spreading through industry. Upwards of 35,000 of them are used to dry automobile bodies and, having proved their merit in that industry, they are now saving time in the drying of resins, inks, blueprints, paper, and latex Small portable units have been developed for drying re-decorated wall surfaces and trim in buildings. These units reduce idle time of office space.

The radiant energy near the infra-red region of the spectrum has a peculiar penetrating quality. It goes right through a paint surface to dry it from the inside out. Thus no outer skin forms to retard the process It works quicker on dark surfaces than light, on rough surfaces faster than smooth ones. No air circulation is required, hence the hazard of dust movement is reduced. Installation costs are relatively low because standard wiring and sockets are used

RADIANT HEATING

Looks as though the same rays which dry the lacquers on automobile bodies would be harnessed to heat buildings. There are several radiant heating installations in this country, more in Europe, and commercial interests are getting behind it. There is much to recommend it for far wider use in this country.

The principles involved in radiant heating were discussed at length at the time of an earlier push (December 1936, page 335), but here is a brief résumé. Radiant heat is a wave of pure energy which warms objects without heating the intervening air You feel it when you stand in front of a pot-bellied stove, a fireplace, or in the sun in the wintertime In the path of these rays, man can be comfortable even though surrounding temperatures are low, because the rays are strong enough to prevent dissipation of bodily heat faster than it can be generated

Early installations called for pipes imbedded in ceilings Through these pipes warm water flowed, and the warmed ceilings radiated heat downward to envelop the occupants A less common installation has metal wall panels heated with water, but this requires four heated surfaces per room Newest idea is to imbed pipes in the floors Water, heated to 85 degrees, Fahrenheit, flowing in pipes, is intended to produce a 65-degree room temperature which is adequate for comfort.

Claims for this type of heating are many and well-founded Installation costs are higher than for convection heating, but there is a saving in fuel, running as high as one third, greater bodily comfort, better control of humidity Complete concealment of heating apparatus is an added advantage. Offsetting to some degree the higher initial cost due to piping is a possible saving in cost of heating plant. Likewise, need for air-conditioning systems is virtually eliminated

Apropos of radiant heating is a home-cooling experiment which simply reverses the process Room walls are covered with two black panels and a layer of aluminum foil. The foil reflects heat to the black panels which absorb it, and both panels and foil are cooled to a temperature of 50 degrees by concealed pipes A marked reduction in operating cost of air conditioning is claimed for this system

SHOCKING NEWS

The extreme dislike for electrical shock which livestock manifest is the cause of some concern among woven wire fence manufacturers

A single strand of electrically charged wire will keep horses, cattle, and pigs just where you want them. One or two good shocks will condition animals to give the fence a wide berth Ergo, farmers are favoring the single wire instead of woven wire fence because of the generous cost saving. Actual installation figures are hard to get, but estimates of controller sales give a good indication Sales have jumped from some 14,000 to 75,000 in four years and the total sales of controller devices, including home-made shocking devices, for this period is put roughly at 335,000. Probably no less than a quarter million miles of electrified fence is in operation.

How much of a headache is this for manufacturers? Not as severe as one might think. There is substitution which has cut into woven fence volume, but much of the electric fence is clear gain The temporary use for utilizing pastures, making exercise pens, lanes, and after-harvesting gleaning areas, means additional wire sales Also, the way is opened to fence large areas hitherto prohibitive from the cost standpoint A rapidly growing use is for protection of existing fences. It will take time to strike a loss and gain tonnage balance. Meanwhile it is a boon to farmers and live-stock raisers.

—*Philip H. Smith*

Maestro of the Atom

Lawrence Had an Inspiration, So Science Now Has the Cyclotron for Smashing Atoms

LORING A. SCHULER

One night, 11 years ago, a young associate professor named Ernest Lawrence sat in the University of California Library, plowing through reports of experiments in physics Mostly they were routine, but one caught his eye

The experimenter had hitched together two long vacuum tubes, and the speed of the electrified particles had been measurably stepped up as they jumped from one tube to the other Why, Lawrence thought to himself, only two tubes? If the fellow had hitched up ten, wouldn't he have got the impelling force of a million volts? — enough, perhaps, to smash atoms? But ten tubes in a straight line would be impossibly long. Why not, instead, a circular vacuum chamber, with two half-round shallow copper boxes, shaped like the halves of a pill box cut down through the middle, as electrodes? Oscillating electric current would shift rapidly from one box to the other, a magnet would straddle the chamber, at right angles If his theory was correct, the same small voltage, used over and over again, would give charged particles a series of electric pushes, while the magnet would keep them going round and round in a compact spiral, something like the spiral on a phonograph record And thus the hopelessly long device Lawrence had first thought of could be made practicable after all The particles would go faster and faster, until perhaps they would pile up the speed needed to crack atoms

That was the birth of the cyclotron, for which the same Ernest Orlando Lawrence has been awarded the great Nobel Prize in physics as the world's number one atom smasher

Today with two huge cyclotrons that he has built at Berkeley — vastly bigger and infinitely more complicated than what he dreamed of that night in the library — he is helping to solve some of the most fundamental and mysterious problems of science

And, in the unpredictable manner of scientific discovery, what started out to be abstract research is turning out to have such practical value that today medical doctors, chemists, biologists, botanists, entomologists and a great many other scientific gentlemen are all thumbing rides on the cyclotron because it promises to take them to places they have never been able to reach before A powerful ray is under experimental use as a hopeful weapon against cancer Artificially irradiated substances, with properties like those of radium, are being created for the study of growth and the treatment of various ailments, while in the field of agriculture plants are being made to tell how they absorb nourishment and make starch and sugar

These are measurable gains in life and health and wealth But there is much more, Lawrence knows, to be found beyond the frontiers that he has already explored, so now he is getting ready to build another atom-smasher, 20 times as big as his biggest, with which he confidently expects to be able to reveal Nature's secret source of energy, tap enormous new supplies of power for industry, and transmute the elements by this modern alchemy

For 25 centuries, men of science believed there was a basic, indivisible particle of matter, the atom, out of which all things were made Then, only a generation ago, evidence piled up to prove that each atom was like a tiny universe, with a nucleus at the place of the Sun, and electrons whirling round it much as Venus and Earth and Mars and Jupiter and the rest of the planets whirl around the Sun All the electrons were identical

Furthermore, it was discovered that there were as many kinds of atoms as there were basic substances — hydrogen and oxygen and sulfur and zinc and tin and copper and silver and gold and radium, and so on to the number of 92 in all, which were called elements What made each one different from the others in chemical properties was the number of electron planets that each individual atom had spinning round its nucleus sun Hydrogen, for example, had one electron, oxygen had eight, copper had 29,

The 220-ton cyclotron at the University of California. The big chunky rectangle, with vertical pole-pieces in its middle, is the huge magnet. Between these pole-pieces is the main, "business" part of the apparatus, the circular vacuum chamber containing two electrodes, also the space where projectile particles are speeded up. Power source is on balcony

tin had 50; gold had 79; radium had 88, and uranium, heaviest of all, had 92. The elements are known in science by those "atomic numbers"

But strangely enough the electrons, which are charged with negative electricity, could be removed without essentially changing the character of the atom It would still be an atom of gold or iron, for example So, the researchers said, there must be something in the nucleus, with its positive electric charge, that we don't know about, and inquisitively they turned experimental guns against the little sun that was the center of each atom universe Did the nucleus, too, have smaller parts? They found that it did, and named those parts protons and neutrons And said that here at last were the elemental building blocks out of which everything in the world was made Meat and potatoes, gold and iron, oil and water — all substances were made of the same protons, neutrons, and electrons, arranged in different patterns That statement still stands, though Lawrence may find something else when he has built his bigger cyclotron

But, it may be asked, how did the scientists themselves discover all this about particles which they could not see? Mostly by the painstaking accumulation of evidence They could take photographs of the tracks of particles in motion, showing streaks like tiny comets, and they could "hear" two particles collide in a vacuum when the effect of their collision was amplified and converted to sound

It is easy enough to strip the electrons from an atom The ancients did it, though they didn't know it, in that first electrical experiment of rubbing amber with a piece of cloth But smashing a nucleus is quite a different matter More than 2,000,000 atoms could lie in a straight line across the dot over the letter i. And each nucleus occupies no more space in its atom universe than a fly in a cathedral The protons and the neutrons are held together by forces of enormous strength. Here is the storehouse of atomic power. To separate the particles, so that the power could be released, would take prodigious energy. That was why Ernest Lawrence, back in 1929, was yearning for a million volts

Scientists were pretty well agreed that only an atom could be used to smash another atom. If one lot of atoms, they figured, could be made into high-powered, high-speed bullets and fired at another lot of atoms, those that were hit might be smashed The problem was how to get the necessary power and speed A couple of German physicists built an elaborate apparatus to harness the lightning, they might have had something if they could have manufactured thunderstorms at will

The same cyclotron viewed from the power supply house on the balcony. Nearer cylinder is a vacuum chamber down which particles finally speed

THE virtue of Lawrence's idea was its comparative simplicity Along in the spring after that night when he made his first sketch in the library, he got around to making a model of the device, exactly following his original specifications It was only six inches in diameter — a couple of D-shaped shallow copper boxes, mounted between circular pieces of glass and sealed with red sealing wax But when the air was pumped out and a borrowed magnet was held at right angles to it and the current was turned on, particles actually did spiral round and round at increasing speed The thing worked

Later, he built another one, a little bigger, and that worked, too, with even higher velocity Still, he wasn't smashing any atoms, but he was speeding up electrified particles to greater and greater velocities

For this he needed a magnet of tremendous size, and, though maggets like that don't grow on trees, he was lucky enough to find one that had been junked in California when the Chinese government failed to pay for a radio broadcasting outfit of which it was a part It weighed 74 tons.

There were exciting days and nights in the dusty old radiation laboratory at Berkeley while the first working cyclotron was being built Discouragements when it wouldn't perform according to schedule, cheers when the difficulties were overcome Parts melted off under the terrific heat that was generated, and were replaced by water-cooled contrivances. Lawrence was everywhere, driving his small crew of helpers, working like a madman himself, taxing even his own great ingenuity to devise ways of getting results without spending money

But it worked! It really did smash atoms It did more than Lawrence or anyone else had expected it would Weirdly, it performed unexpected transmutations Sodium, with an atomic number of 11, became magnesium, 12, by capturing a neutron out of a heavy-hydrogen nucleus that was shot at it Aluminum, 13, became phosphorus, 15, by swallowing an electrified particle of helium Nitrogen, 7, dropped a helium nucleus and became boron, 5, when it was bombarded with neutrons There were even more complicated changes, and as time went on the laboratory workers found that they could make five different substances out of any element that they put under fire in the cyclotron — they could add or subtract one number or two, producing absolutely different elements, or they could make a variation of the original material.

Other things happened, too After being bombarded by the cyclotron's fast-flying particles, all the lighter elements, at least, de-

veloped the curious power of throwing off rays, which only radium and its immediate family can do in nature. They were, in scientific terminology, "radioactive."

That calls for some explanation, which for the sake of clarity must start with the operation of the machine itself.

Into the very center of the cyclotron, between the two semi-circular hollow copper boxes, is admitted a stream of atoms of hydrogen or heavy-water hydrogen or helium. A tungsten filament ionizes them—that is, strips off the electrons, leaving the nuclei as naked positive charges They are caught up by the alternating 80,000-volt electric field from the cyclotron's powerhouse. But as they start off in a straight line, the powerful electro-magnet swings them into an arc Then when they dash across the gap between the two D-shaped boxes, the quickly reversed voltage picks them up and kicks them on again

A HUNDRED or more times this happens Round and round the ions spiral in ever-widening circles, picking up speed at each half turn while the voltage reverses some 20,000,000 times a second. It is the principle of the old rope swing—with the original 80,000 volts magnified by each hundred half circles of acceleration to 8,000,000 volts. And by the time they reach the outer edge of the copper boxes the particles are traveling at a speed of 18,000 miles a second, which is 35,000 times faster than a rifle bullet.

At the exit, a target is set up, smeared with sodium or phosphorous or some other element. The speeding ions strike the quiet atoms in the target, and, though the aim is inexact, two quadrillions — 2,000,000,000,000,000 — of bullets every second, concentrating on a target of two square inches, are bound to make some direct hits.

When an atom is "smashed," the protons and neutrons in its nucleus are rearranged Here, for example, is an atom of boron A physicist would draw the picture of its nucleus as a circle, with ten little spheres inside, five of them representing protons and five of them neutrons The atom is hit in the cyclotron by a charged particle of heavy-water hydrogen, known as a deuteron, which may be drawn as a circle containing two little spheres, one a proton and one a neutron. The boron and the deuteron combine. There are now six protons and six neutrons, which make carbon. One substance has been transmuted into another The new hot carbon throws off one neutron at once, in its effort to regain stability, just as boiling water throws off steam in an effort to get cool But it still has an excess of energy, and some time later it will throw off still another particle. That is radioactivity.

The vacuum chamber unit removed from the apparatus, with its top off. Inside it are the two semi-circular, D-shaped electrodes, separated by a narrow gap and each supported by a heavily insulated support. Pipe fitting connects with the vacuum pump line. Next to right is the deflector, then one of four casters on which the entire unit may be rolled from between the polepieces of the magnet. Nearer the reader are the window for particle exit and the target holder

Some elements expel these excess particles almost immediately. Others let them stay for a while, and then toss them out, perhaps in a minute or an hour or a matter of years. Nature abhors instability, and each atom tries to regain the stability that it lost when new particles crowded into its family circle

The cyclotron makes radioactive substances easily, and from many elements The doctors pounced upon it quickly when that was discovered Radium is very rare and very costly. It can be dangerous as well as beneficient. The artificial radioactive substances have a shorter active life than radium, which is an advantage because they can be used internally with less danger. And besides they cost a great deal less—a day's bombardment of a common salt produces radioactive salt that for a day or two will do the work of several hundred thousand dollars' worth of radium

Twenty departments of the University of California are now demanding radioactive products from the cyclotron for their own studies. Biologists are using them to study growth and metabolism. Botanists are having fertilizers irradiated, so that they can find out how growing plants use these "labeled atoms." With radioactive carbon they are learning how plants combine carbon dioxide, water, and sunshine to make starch and sugar. In insect research, sodium is traced through the pests. In industry, radioactive hydrogen is helping to perfect petroleum refining, and radioactive salt can be used instead of radium and X-rays to find defects in battleship armor

There's more and yet more Beryllium atoms under bombardment give up neutrons in such great quantities that a healing ray, something like the X-ray or the gamma ray of radium, has become known The doctors have already used this neutron ray with fair success to halt the wild growth of cancer cells in animals, and some of them believe it offers the most powerful weapon against human cancer that has yet been found

BECAUSE of the medical value of both the neutron ray and the radioactive substances, a new cyclotron, with a magnet weighing 220 tons, was built on the Berkeley campus last year, and 35 other cyclotrons have been built in other states and other nations

Lawrence's next cyclotron will be tagged for fundamental research, to unfold the secrets of atomic power and transmutation. Its construction will take three years, and will cost $1,400,000, of which $1,150,000 have already been given by the Rockefeller Foundation. Its magnet will weigh 4900 tons It will generate 100,000,000 electron volts, perhaps much more. It will be built high in the Berkeley hills, and its operators will huddle in an underground control room, 150 feet away, when the machine is running.

So powerful an engine of atomic disintegration is dangerous as well as useful. Even the present big cyclotron—one twentieth the size of the one to come—is treated with respect by scientists. Five-foot-thick walls of lead and water protect them from flying neutrons.

When the cyclotron is running nothing moves except the atoms whirling in the vacuum chamber, and you couldn't see them even if you were at the heart of the machine. If you should stick your hand into the deuteron beam which is sometimes released as a spec-

tacular stream of bluish-lavender light you would be burned as if you had fooled with a blow torch

Will industry eventually be able to harness atomic power? There are two ways in which this might conceivably come about. Both have been sufficiently proved to take them out of the class of pure theory; neither is at all near to the stage of practicability now

The first is energy produced by fission, or splitting, of an atom Within the past year, atoms of uranium 235, an isotope, or variety, of the heaviest of all elements, have been split by neutron bombardment, which divides them into types of other lighter elements, with the release of immense energies On paper, the splitting of a uranium atom produces 50,000,000 times the energy release resulting from the burning of an atom of carbon in coal, though researchers quickly reduce this ratio to 17,000 because of scarcity and other factors The released energy from uranium manifests itself as heat, and if enough could be had steam could be produced to run factories

The trick will be to bring about what is called "chain reaction," which seems possible because when uranium 235 splits excess neutrons come out, and these, in theory, will attack other atoms and start a chain disintegration with a ceaseless and increasing flow of heat

So much for theory On the basis of facts now known, coal isn't likely soon to be supplanted by uranium Only uranium 235 will split and very little of this has been purified, an increase in consumption would boost the price out of sight; and, last but not least, uranium has a disconcerting high-explosive quality—because of which the Nazis are trying to lay hands on all the uranium they can find

THE other theoretical method of squeezing power from the atom is by annihilation Two electrons will disintegrate into a wave of energy when they collide. From this, physicists reason that a far greater emission of energy would result if they could make the heavier protons and neutrons kill themselves off in the same way.

Lawrence has written: "A simple calculation according to the relativity theory shows that a glass of water, if completely destroyed and converted into useful energy, would yield more than a billion kilowatt hours, enough energy to supply a city with light and power for quite a time."

The released energy, if it could be produced at will, would be in the form of heat, which could then be used to make steam, to turn generators, to make electricity for the use of industry.

Lawrence also says "When we can produce atomic projectiles of 100 to 200 million volts, we shall be able to unloose new energy, in light and heat We shall have new riches perhaps more important than those we have already found Radium gives off enough energy to raise its own weight of water to boiling temperature every hour, and it continues to do this for thousands of years. There is reason to hope that we shall find the means of releasing the vast store of energy in the nucleus of commoner substances Indeed, this is more than a hope; it is already a likely possibility"

Co-workers in the laboratory call Lawrence the "Maestro." He is a big man, tall and broad of shoulder, with eyes that are always busy behind his low-set spectacles, and a big, wide, tooth-filled laugh He plays a good hard game of tennis, has a cruising boat on San Francisco Bay that he won't take out unless there is rough water to make things exciting Most of all he's curious and generous and honest, sharing each triumph of achievement with associates who love to work with him

At 38, he is in the top flight of great physicists, and, as one friend wired him on the day the Nobel award was announced "Dear Ernest, your career is showing promise"

• • •

More About the Cyclotron

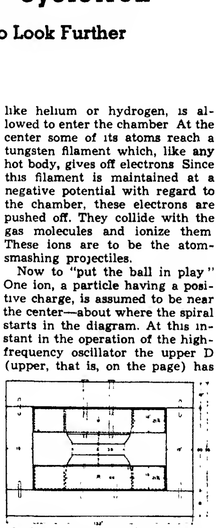
For Readers Who Wish to Look Further into its Technical Details

THE cyclotron is a sort of electrical slingshot for imparting high velocities to sub-atomic particles, in order to crack atoms apart by shooting these projectiles at them

The accompanying drawings reveal the essential workings of the cyclotron Inserted between the pole-pieces of the big powerful magnet, but otherwise not connected with it, is the vacuum chamber, shown in one of the photographs of the previous article The two "D's," so-called by physicists because of their obvious shape, are semi-circular, hollow, shallow boxes, which *are wide open* along their straight facing sides They do not touch the chamber As the diagram shows at its left side, they are connected, as capacities, to a radio-frequency oscillator circuit, through an inductance.

To outline the essentials of the cyclotron let us assemble and operate it. First, the cover of the vacuum chamber shown in the photograph in the previous article is replaced and sealed, the chamber is inserted between the poles of the magnet and the interior is exhausted to a high vacuum. Then a small amount of some light gas, like helium or hydrogen, is allowed to enter the chamber At the center some of its atoms reach a tungsten filament which, like any hot body, gives off electrons Since this filament is maintained at a negative potential with regard to the chamber, these electrons are pushed off. They collide with the gas molecules and ionize them These ions are to be the atom-smashing projectiles.

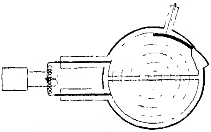
Now to "put the ball in play" One ion, a particle having a positive charge, is assumed to be near the center—about where the spiral starts in the diagram. At this instant in the operation of the high-frequency oscillator the upper D (upper, that is, on the page) has



Courtesy Journal of the Franklin Institute

Cyclotron magnet for the Biochemical Research Foundation

attained its maximum negative potential—perhaps 90,000 volts Therefore the particle is attracted toward it It does not travel straight toward it but is forced into a curve by the powerful uniform magnetic field passing vertically through the vacuum chamber lying between the pole-pieces. Because the D is hollow and has no wall along its parallel side, the particle does not hit the D, even when it reaches it,



Plan showing main elements of a cyclotron's vacuum chamber

but simply enters its open interior space This space is practically field-free, but momentum carries the particle ahead and the magnetic field curves it on around. Just as it emerges from the D, the high-frequency oscillator has changed to its opposite phase and the particle therefore is drawn again across the gap, acquiring a doubled velocity as it is attracted

The rest, for some 100 revolutions, is simply a repetition of the same performances—kick after kick that adds increment after increment of speed ("multiple acceleration") to the particle Why doesn't it travel in a circle instead of an approximate spiral? Because the radius of its arc after each increase in speed is proportional to the new velocity

All these things have been taking place actually at the rate of 20,000,000 swift kicks per second Just as the long-suffering particle has decided that existence for it hereafter must be just one revolution after another, with no hope of ever attaining a permanent, fixed position in life, it has spiralled outward to the edge of the chamber Here there is a plate charged to a high negative potential, perhaps 70,000 volts This pulls the particle aside and it dashes through a mica "window," thick enough to exclude the outside air but "mostly hole" for smaller things, and flies at the atoms which it is to crack in the target chamber This particle has not, however, been alone, for trillions of similar particles have accompanied it on the merry-go-round. How are they aimed at their target? They are not individually aimed at all. It is more like throwing stones at a neighbor's fruit tree in the dark when you were a boy —some of the stones hit some of the fruit —*A G I*

ELECTRON VOLTS

So Often Seen in Print—

So Seldom Interpreted

WHAT does this peculiar term signify? Very loosely, velocity To most of us, electron volts are a new variety of volts How can volts mean velocity? Like many other common expressions, this is one that does not mean what it says any more, for illustration, than F 4 5 or F 8 really means speed in a lens, instead of a ratio that can in turn be interpreted in terms of speed The amount of kinetic energy acquired by an electron when it has been accelerated through a potential difference of one volt is an electron volt. So electron volts aren't a measure of speed, after all, but of energy. It is, however, one of our mental preferences that we like to think of kinetic energy in terms of something else that we can more easily observe—that is, speed Should a newspaper reporter correctly state that "two cars met head on, with the liberation of so-and-so many foot pounds of kinetic energy," instead of "two cars met head on at 70 miles an hour," he would lose his job It is true, nevertheless, that velocity itself never smashed a car or even an atom—the kinetic energy in an object moving at a velocity is what does the smashing

To convert electron volts into miles per second requires nothing worse than doing a patch of arithmetic the size of one's hand, a complication in the calculations being the fact that the mass of a flying particle increases with its velocity (the "relativity" increase) When the particle attains velocities comparable with that of light its mass becomes considerably greater.

Another question is: "If the particles used in cyclotrons are not electrons but other particles, according to the atom-smashing effects desired by those who operate them, why is the term 'electron' volts used at all?" The electron volt as a unit of energy can be applied to other atomic particles because the charge on any such particle is an integral multiple of the electronic charge. Here are some examples of electron volts translated into terms of speed. An electron in a one-volt field would move at 369 miles a second, a proton at 8.69 miles a second, and a deuteron something over half as fast These, of course, would be slow, lazy particles. In cyclotrons the speeds read more like scores of thousands of miles a second

Sometimes confusing is the frequent terminology in sentences like the following "The atoms of uranium 235 are split, with the release of 175,000,000 electron volts." Again the meaning is, simply, energy It is easier for the physicists to state it thus than in such terms as horsepower, though this could be done, and it would be as scientific Conversely, you could, after wrestling with some arithmetic, express the speed of your car in terms of electron volts, but it probably wouldn't impress the judge —*A G I.*

RAMAN EFFECT

Theoretical Discovery Now

Has Practical Value

ABOUT ten years ago an Indian physicist, Sir C V Raman, using refined equipment, discovered that the light scattered by individual molecules is not all of the same frequency as the incident light, but that a minute amount of this scattered light consists of different frequencies When light strikes a molecule and the electrons interact with it, sometimes a fleeting change is caused in the vibrational state of the electrons This sudden change causes the "springs" holding the atoms together to jerk and so, part of the time, makes the atoms vibrate Thus, part of the energy of the incident light is converted into the vibrational energy, so that the light which leaves the molecule has a lower frequency than the incident light.

The differences between the incident frequency and the various scattered frequencies form a pattern, a "Raman spectrum," which is characteristic of the molecule doing the scattering The appearance of the Raman spectrum of a mixture of different molecules may tell a chemist what molecules are present in the mixture, while the relative intensities of the lines in the spectrum indicate the relative amounts of each. A number of new compounds have been discovered in this way.

BROWSING with the Editor THROUGH THE SCIENCE LITERATURE OF THE WORLD

WORKER'S WEALTH —Over half the "wealth" produced in motor plants goes to workers who build the cars —Automobile Manufacturers Association, 366 Madison Avenue, New York, New York

GRAPE-FRUIT OIL —An oil with a nut-like flavor, useful in industry, cooking, and as a salad oil, is now being extracted from grape-fruit seeds—United States Citrus Products Station, Winter Haven, Florida

FREEZING WATER —Experiments prove that, contrary to a widespread impression, hot water does not freeze more quickly than cold water.—*Science*, p 384, (April 19, 1940)

CHAMELEON'S TONGUE —A seven-inch chameleon can capture a fly 12 inches away without moving His artillery consists of a tongue longer than himself, a lightning-like sticky-tipped weapon which is shot out of the mouth in much the same way a watermelon seed can be shot from between the fingers Ring-shaped muscles contracting suddenly on a slippery, spike-like bone send the tongue forward —*Natural History*, (May 1940)

OZONE, NO BACTERICIDE —Ozone, regardless of where or how it is generated, has little or even no effect on bacteria or germs —*The Journal of the American Medical Association*, p 1633 (April 27, 1940)

ANT FORTRESS —A small South American tree, the barrasanta, is a fortress garrisoned by ants A ferocious species of ants invariably live in its hollow stem and rush furiously out to attack any man or animal that disturbs the tree — O L Haught, Smithsonian Institution

SULFANILIMIDE —Experiments have shown that sulfanilimide destroys disease germs by letting them kill themselves with the hydrogen peroxide they themselves create.—*Science Service*, (April 3, 1940)

SMALL OIL PRODUCTION.—"Since the foundation of the oil industry, the entire world's production of crude oil would not fill a hole a cubic mile in the earth "—Dr. Gustav Egloff, *Science*, p 535, (June 7, 1940)

KEEP GAS OUT OF THE EARS —Rubber ear caps are now being made to protect wearers against certain war gases which, if allowed to penetrate the inner ear, would make decontamination extremely difficult It is also claimed that they will protect the ear drum from blast —*India Rubber World*, May 1, 1940

DANGEROUS AUTOMOBILE DOORS —Each year about 300 persons in the United States fall to their death through doors of moving passenger automobiles which they open in order to slam them shut The rush of air swings the door completely open, pulling the person out of the vehicle —*Statistical Bulletin*, Metropolitan Life Insurance Company, April 1940

WE'RE NOT SO HUNGRY.—During 1939, the average person consumed something like 100 pounds less food than the average person did in 1900 Today, electricity does work in factories, homes, and farms, which used to make people develop man-sized appetites.—Dr. O E Baker, U. S. Department of Agriculture.

NEW INDUSTRIES.—Fifteen million Americans now work at jobs which did not exist in 1900 —Everett S. Lee, General Engineering Laboratory, General Electric Company.

BETTER FREIGHT SERVICE —Today's freight trains can do more work and do it better and in less time than those of 20 years ago. Freight cars average eight tons more in carrying capacity; locomotives average 43 percent more pulling power; and freight trains go 64 percent faster, on the average —Association of American Railroads.

TO FIND MORE OIL —Around 6000 geologists, geophysicists, chemists, paleontologists, and other scientific workers, are said to be engaged nowadays in the search for oil —Thomas A Boyd, speaking before The Franklin Institute, April 29, 1940

FOREST FIRES FROM CARELESSNESS.—Only 10 percent of the forest fires that burn more than 34,000,000 acres every year are due to natural causes, such as lightning The rest are man-caused —The American Forestry Association

RUBBER FROM HOME-OWNED PETROLEUM —"In 1939, about 1,100,000,000 pounds of natural rubber were used in this country Over 200,000,000,000 pounds of synthetic rubber could be produced from ethylene from the cracking process "—Dr Gustav Egloff, *Science*, p 538, (June 7, 1940)

CHEAPER LIGHT BULBS —In 1900, the cost of electric light bulbs was approximately one cent per candle power of light In 1939, the cost was less than one sixth as much, and the power consumption less than one fourth as much, per candle power —Dr A. W Hull, General Electric Research Laboratory.

NO SILVER —There is no silver in nickel-silver It is an alloy of nickel, copper, and zinc —*White Metal News Letter*, May, 1940

DIPHTHERIA DEATHS.—A record of no diphtheria during an entire year has been achieved by 32 cities in the United States —*Science Service*, May 8, 1940

TREATING SINUSITIS —While there are various preparations or treatments that are of temporary palliative value in giving relief from the symptoms of sinusitis in some but not all cases, there is no known home treatment that is a cure or competent remedy for this condition —National Better Business Bureau, Inc , May 24, 1940

SAFE RAILROADS.—A person is safer on an American railroad train than in his own home, according to statistics During the past 10 years, fatalities to passengers in train accidents averaged only one for each 1,498,000,000 miles run —Association of American Railroads

NICKEL USE.—Of the 210,194,000 pounds of nickel sold during 1939 by International Nickel, the United States alone consumed 101,200,000 pounds, or nearly half the production of the world"s largest producer —*White Metal News Letter*, May, 1940.

CIVIL ENGINEERS —One hundred years ago there were but two main types of engineers "military" engineers concerned with the operations of warfare, and "civil" engineers engaged with problems of civil life For a time, all engineering in civil life was called civil engineering, but soon major differentiations developed . . —*Engineering Opportunities*, by Dr. Karl T. Compton

An Ideal Experiment

Taking the Moon's Temperature During an Eclipse Reveals a Phenomenally Big Drop

HENRY NORRIS RUSSELL, Ph.D.

Chairman of the Department of Astronomy and Director of the Observatory at Princeton University Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington

"COLD moonlight" is poetry and fact in the same phrase The Moon's light carries so little energy with it that, as a source of warmth, it is much less satisfactory than the English lodging-house fireplace which Howells once described as having "the capacity of a pint-pot and the heating capability of a glow-worm" But modern heat-measuring devices are so sensitive that the imperceptible heat of the Moon's rays may not only be measured with precision, but afford a basis for a reliable determination of the temperature of its surface

There is no difficulty, in principle, in throwing the image of a planet, or of some portion of the Moon, upon one of the two junctions of a balanced thermocouple circuit, and recording the current set up by the heating of this junction by the incident radiation In practice, a very high degree of manipulative skill is required, to construct the tiny thermocouples, to keep the galvanometer at the highest sensitivity, and to shield the whole circuit from the many sources of extraneous disturbance Work of this sort was done years ago at the Lowell Observatory by Coblentz and Lampland, and at Mount Wilson by Pettit and Nicholson—who summarized their observations in an extensive catalogue of "radiometric magnitudes," calibrated so that from the entry for each star it was easy to derive the actual amount of radiant energy which the star sent to a given area of the Earth's surface.

The theoretical interpretation of these data is much complicated by the fact that the energy we can measure at the Earth's surface is much less than we would observe if there was no atmosphere above our heads—and if we could survive to make our measures The Earth's atmosphere is tolerably (though far from perfectly) transparent to visible light, but highly opaque in many regions in the ultra-violet and infra-red Hence we lose a great deal of the radiant energy from some bodies (most of all from the hot, white stars) and have to make allowance for this with much labor and pains. The worst of it is that the most powerful absorbing component of the atmosphere is water-vapor, and the amount of this varies from day to day and even from hour to hour We can get a general idea of the amount of water-vapor above us by measuring the humidity of the air at the ground level—or at that of the observatory floor—by the ordinary methods used by meteorologists. If this air was a fair sample of the great atmospheric ocean which extends a hundred miles and more over our heads, we could proceed comfortably with our calculations, but obviously when the wind is from the north high up, and from the south low down, the surface air may be a poor sample of the whole

LUCKILY, there is a "window"—or spectral region in which the air is nearly transparent—for wavelengths about 20 times as long as those of visible light. For longer waves, the atmosphere is entirely opaque, and for shorter ones it is full of regions of heavy obstruction.

This "window" comes just in the right place for the student of planetary temperatures. The heat carried by the sunlight reflected from the planet is, for such observations, only a nuisance. The heat given out from the planet's own surface is what is wanted. This radiation, coming from a surface at a temperature more or less like that of the Earth's surface, is carried mainly by long waves, while sunlight contains a great preponderance of short waves Of the two clear spectral regions in the transmission of the atmosphere, one lets the sunlight through, little weakened; while the other is open to the planetary heat—though not wide enough to admit it all.

Our thermocouples, of course, measure the sum of both but it is easy to separate them A microscope cover-glass, 1/150 of an inch thick, blocks out most of the long wavelengths, and a cell containing water between quartz plates obscures it completely—though both are substantially transparent to sunlight By interposing one or other of these screens in the path of the rays, and repeating the measures, the energy cut out represents approximately that radiated from the warm surface of the planet, and that which still gets through, the reflected sunlight Exact allowance for the small fractions of either one which are not completely stopped or let through is easy enough Needless to say, the observations must be made with a reflector, so that the rays are not obliged to pass through any glass.

In this way the reflected sunlight is eliminated, and the corrected reading represents the heat which would be received from the planet itself if the sunlight could be cut off from it for an instant, before it had time to cool.

The amount of this heat evidently depends upon the size of the portion of the planet (in square seconds of arc) whose image falls on the thermocouple Allowing for this, there remains a quantity which depends on the temperature of the radiating surface. If the surface was a standard radiator — or "black body" — and the atmosphere was not in the way, this quantity would be proportional to the fourth power of the temperature, and the rest would be easy.

Allowance for the loss in passing through the atmosphere demands laborious calculation, but can be reliably made (subject to the uncertainty of the humidity of the upper air). Whether the surface behaves like a standard radiator or emits less is sometimes doubtful; but the Moon is doubtless composed of rocks not much unlike igneous rocks on Earth, and these, for long waves, are not far from standard in their radiating properties.

The amounts of heat which

would be received, by a faultless detecting device, from a body of given size at various temperatures, observed through the Earth's atmosphere under standard conditions, have the following relative values:

Temperature			
			Heat
°K	°C.	°F.	Received
400	127	260.6	1000
350	77	170 6	583
300	27	80 6	285
250	—23	— 9 4	117
200	—73	—99 4	31
150	—123	—189 4	3 2
100	—173	—279 4	0 048

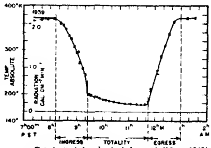
The influence of the transmission "window" is clearly seen in these figures Were the radiation unobstructed, the heat received would be 16 times as great if the absolute temperature were doubled Between 200° and 400° the ratio of increase is 32, from 150° to 300°, 88, and between 100° and 200°, it is 650.

EVEN at the higher planetary temperatures, a great part of the radiation is of such long wavelength that it does not get through the atmosphere At lower temperatures a larger and larger fraction of the radiation goes over into this inaccessible region until at last only a beggarly remnant remains observable.

This adds to the accuracy of the measurement of planetary temperatures in the middle range, near 200°K, or absolute At temperatures much below 150°K., there is very little left to measure, and at 100°K only 1/80 of the already feeble radiation reaches the Earth's surface.

This makes it very difficult to measure the true surface temperatures of the remoter planets of our system, from Uranus outward, for a simple theoretical calculation shows that they are practically certain to be below 100°K.

Taking all these things into account, Pettit and Nicholson derive a formula — which runs twice across the page on which it is printed — in which all the corrections are included. Ten years ago, from a long series of measures on various parts of the Moon's surface, they derived consistent and reliable values for its temperature The hottest part of the Moon is of course the "sub-solar point" where the Sun's rays fall vertically upon it. As we shall soon see, these rays have had plenty of time to heat it up in the week (measured by our time) since the Sun rose above the lunar horizon, and the surface is practically as hot as it would get if the sunlight kept on playing upon it forever Under these conditions, the temperature rises to 374°K (in centigrade degrees above the absolute zero), which is the same as 101° centigrade, or 214° Fahrenheit. At greater distances from this point, where the sunlight falls more obliquely, the temperature gets lower, and the dark side of the Moon is extremely cold



Courtesy *Astrophysical Journal* (May, 1940)

The Moon's radiation and temperature near sub-solar point

What would happen if the sunlight should be suddenly cut off? The surface, having no internal supply of heat of any account, would cool by radiation into space how rapidly?

Nature performs this experiment for us every time there is a lunar eclipse The interposition of the Earth cuts off the sunlight—not instantaneously, but in about an hour Under favorable circumstances, a given spot on the Moon may remain in darkness for more than two hours and a half, though the time during which the whole disk is obscured is about an hour shorter.

The faint reddish light refracted by the Earth's atmosphere into the shadow, which enables us to see the eclipsed Moon, is so feeble that the heat which it carries can be quite neglected, so that we have practically an ideal experiment

Lunar eclipses, visible at a given observatory, with the Moon high enough in the sky to be well observable throughout all the phases, are none too common. Pettit and Nicholson observed one at Mount Wilson in 1927 (June 14) and the next one when weather and other conditions were satisfactory happened on October 27, 1939, and was well observed by Pettit. It was not necessary to use one of the great telescopes for the observations — a 20-inch reflector collected ample energy.

The sky was very clear, the weather steady, and the Moon high in the sky Both a cover-glass and a water-cell were used to separate the reflected sunlight and radiated heat, thus enabling two almost independent sets of temperature determinations The two are in excellent agreement In the figure the squares mark the cover-glass observations, the dots those with water-cell. The point observed on the Moon was not quite under the Sun, and the surface temperature there, before the eclipse, was 99°C As the Sun's rays were cut off, the radiation from the Moon fell rapidly — almost in exact proportion to the loss of incident energy When totality began (for the observed portion of the surface) its temperature had dropped by 172° centigrade, and was —99°F An hour later it was lower by 18°C., and, just before the sunlight returned, it was —97°C., or 144 degrees below zero Fahrenheit!

IF the Moon's surface were composed of solid rock, it could not cool so rapidly, for heat would be conducted up from the deeper layers, and prevent so precipitate a change Only a loose agglomerate, like pumice or volcanic ash, could interpose so effective a barrier to the escape of internal heat Such substances are just what one might expect to find on the surface of our satellite, so that there is no difficulty about believing this. Pettit calculates that the cooling during the recent eclipse, though amounting to a drop of 350°F. at the actual surface, involved mainly only the outermost inch of depth. A few inches deeper, the cooling must have been very small

During the long lunar night, the surface temperature must fall very low. The slower alternation of these changes would cause their influence to penetrate deeper, but, could we visit the Moon, and find a cavern leading into the surface, we would probably find a nearly uniform temperature, 20 feet underground.

The Earth gets as much heat from the Sun as the Moon does, and has much longer to cool down every night than the eclipsed Moon is permitted. Were there no atmosphere or ocean on our planet, its surface temperature would probably undergo almost as extreme variations. It is in more than one way, therefore, that air and water make our world habitable.

The Temple of the Effigy

Evidences Unearthed in Ohio Afford Clear Proof of a Grisly Mound-Builder Rite

WILLIS H. MAGRATH
Affiliate The Society for American Archeology

A PREHISTORIC stone eagle effigy, the only one of its type known, according to scientists, was recently unearthed inside an ancient mound, by Roy Saltsman, an amateur archeologist of Alliance, Ohio, assisted by the author.

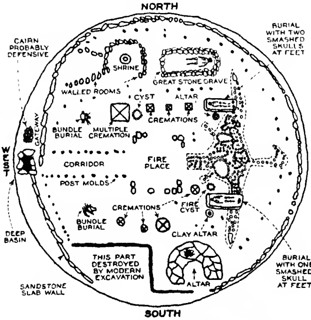
The stone effigy, unique because of its position inside a mound, is part of the trappings of a prehistoric temple of worship, and has been evaluated by Richard G. Morgan, Curator of Archeology at the Ohio State University, as belonging to the Hopewell Culture of early Mound-Builders.

The mound, which occupies a commanding position on the hill overlooking the village of North Benton, in northeastern Ohio, was encircled by large sandstone slabs set end to end. Inside this stone wall, the former existence of a second wall of wood was indicated by the charred stumps of pillars which had supported a nearly circular building 70 feet in diameter. Entrance to the structure was on the west side, through a gateway wide enough to permit the passage of but one person at a time.

Inside the gateway was found a hard-beaten corridor bordered on either side by the black molds of the posts which had helped support the inner parts of the structure.

On either side of the corridor were lines of cremated burials—charred bones on raised, truncated earthen cones—together with crude stone altars bearing the marks of fire. On other squat clay cones, rested offerings of stone implements, mica, cannel coal, galena, and copper, while there were two bundle burials—bones previously buried elsewhere, exhumed and brought here.

The corridor ended in a square fireplace, exactly in the middle of the temple floor, over which there would have had to be a hole in the roof to carry off the smoke of ceremonial fires and the stifling stench of burning sacrificial corpses.



General plan of the Temple of the Effigy

Eastward of the fireplace, where the slanting light of the afternoon sun would strike upon it through the hole in the roof, was the fantastic eagle figure, made of white sandstone slabs resting on an understructure of molded clay. It measured 32 feet across the expanded wings and 16 feet from head to tail, and was headed toward the rising sun.

Overlying the eagle's wings two skeletons were found—the one on the south that of an abnormally large male, that on the north that of a female, the latter showing marks of disease. Both burials were accompanied by rich offerings of flint, bone, and metal.

Among the offerings placed with the male were a pair of spool-shaped copper ear ornaments and a platform pipe, the first such objects to be reported from this region. The inner portions of the ear-spools were lined with buckskin, secured by a twine wrapping about the mid-section, an apparent indication that these people knew the injurious effect of absorbing copper salts into the skin, and sought to avoid it. A hollow copper globe found with the female is perhaps unique.

These two burials, perhaps those of a king and queen, were distinguished by remarkable deposits of smashed human skull fragments strewn about the feet, apparently an instance of human sacrifice. This conclusion was reached with extreme hesitation, as it is not in accordance with finds made with other branches of the Hopewell Culture. However, a large horseshoe-shaped stone platform found near the eagle's southern wing tip bore evidence that seemed to admit of no other interpretation. This evidence consisted of a litter of smashed human skulls, together with incrustations of ceremonial red paint, upon the slabbed top of the structure. That wanton violence had been visited on these skulls was evident from the smashing of even such solid structures as the mastoid process, while splinters of bone had been driven down into the crevices between the slabs. Gashes in the soft sandstone indicated that the instrument used to effect this demolition probably had been an axe.

THIS barbaric altar was examined in the clean light of open day, under conditions that must have contrasted strongly with its appearance when it was part of a mound-builder temple. Perhaps most of the rituals performed on it must forever remain a mystery, yet enough evidence remains to permit at least a partial reconstruction of what went on here when human heads were smashed and the gruesome fragments strewn at the great chief's feet. For when the great chief was stricken dead, this could indicate only that the gods were angry with the people, and it required atonement which, in the case of someone so exalted, called for human sacrifice.

Illuminated by fitful fires from the sacrificial altars, with such feeble shafts of sunlight as could penetrate the smoke reek, fantastically-garbed priests move about in the space before the curving altar, performing their offices.

The chalk-white slabs of the Eagle effigy catch the light and make a weird background for the figure of the dead chief lying upon a catafalque of sand

Diagonally above his left shoulder boulders have been placed to form a circle, and now a fire burns brightly in this cyst As the flames leap higher a priest moves forward, tossing in such personal property as the chief will not want to take with him on his long journey

Occupying a similar position with respect to the right shoulder is a squat pyramid of molded clay Upon the pyramidal altar is a greenstone hatchet, a great polished celt of schist shot through with sparkles of white and yellow mica, and several lesser implements These are the tools the chief loved and the ones he will want to take with him when his soul goes outward bound toward the rising sun upon the strong eagle's wings

FARTHER back in this macabre chamber of sorrow—back beyond the supporting pillars and the lines of cremated burials —are the living nobles and chiefs, while the gloom-filled area along the temple wall is thronged with still other worshippers, all of them manifesting the most poignant grief

Behind the ceremonial, horseshoe-shaped altar, facing the worshippers, is the high priest, fantastically arrayed in towering head regalia, ear-lobes hideously distended with polished copper spools, swart breast hunt with gleaming shells and bear teeth. He has a pouch of ceremonial red paint, and his right hand grasps a massive greenstone hatchet.

The air pulsates with a barbaric rhythm of chants and drumbeats, interspersed at times by the wild shrilling of a Pipe of Pan Guttural commands ring out and there is a commotion near the temple gate. In a moment stalwart braves enter, dragging a fright-drugged wretch whose mind is too palsied to realize fully what is about to happen to him in this stifling place.

The bedlam grows louder, rising to a supreme pitch as the climax of the rite approaches. The braves have dragged their victim to the curving altar, and are forcing him to bow over the slabbed top in supplication Menacingly the high priest raises his hatchet, at the same time sprinkling sacred red paint upon the altar In a moment that altar will be redder than with any ceremonial red paint A hush falls on the crowd, the hush of emotional mesmerism, and in that moment of hush the blow falls, splitting the skull with a soggy impact, like the bursting of a rotten pumpkin Again and again the hatchet strikes, till the thing that was a human head is a shapeless crimson pulp and the body to which it was attached ceases its convulsive twitching and is still

Pieces of smashed skulls strewn about the feet of the buried Indian queen's skeleton

Part of the eagle effigy, with one of the burials lying across its half concealed wing

Pipe of Pan. Half natural size

Contemptuously the subordinate priests kick it aside, while the high priest sheathes his hatchet Then the dripping head fragments are gathered up and strewn about the feet of the great chief. Much of the sodden debris is carelessly overlooked, and remains upon the altar, and there the explorers find it, centuries afterward, telling its long-forgotten story.

Even the Pipe of Pan, which must have played so important a part in the ceremonials, was found It lay upon the breast of an aged man in the great stone grave north of the eagle, a beautifully made instrument, consisting of three bamboo tubes cased in a copper sheath of surpassing workmanship Since it lay upon the breast of the skeleton, exactly over where the heart had been in the long past, the finger bones of the right hand still touched it, as though the Player of the Pipes had sought to protect his instrument from desecration even in death

The Pan Pipe of this ancient musician differs in several ways from the instrument of the classical peoples Where the ancient Greek Pipe of Pan had seven or more tubes, this one has but three. And, while the classic pipe has tubes of graduated length, to produce different pitches, these people made the tubes all the same length, and controlled the pitch by inserting leather plugs at varying distances from the ends of the tubes Thanks to the preservative action of the

The "man sign" found in the grave of the piper shown below

poison copper salts of the sheath, the thing has come down to us out of the past intact; we do not have to guess at it construction.

The very old man in the great stone grave was further distinguished by having at his head a large stone tablet engraved with a "man-sign" in relief. The "man-sign" smacks of Mother Asia, and is used in the ideographic symbols of the Chinese even to this day Now, as for milleniums past, this symbol has meant "God" and "Great". If the "man-sign" meant the same thing with the builders of the Temple of the Effigy that it did with their Asiatic forbears, it would indicate that they followed an anthropomorphic type of worship In this concept of religion God is pictured as a kind of superior human being, with the form of man—a relatively high culture

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MOUND BUILDERS

No Longer are They

A Complete Mystery

A FULL flowering civilization, not essentially inferior to that of the Aztecs in Mexico or the Maya in Yucatan, vanished without a trace in North America, probably a few generations before the first landing of Columbus

This is the conclusion of Frank M Setzler, Head Curator of Anthropology of the Smithsonian Institution, from an effort to reconstruct out of such scattered clues as are available the history of the Hopewellians, the mound builders of the Ohio and Upper Mississippi Valleys [see also details in the preceding article —ED]

From the results of more than a century of research, Mr. Setzler explains in a study just published by the Institution, a tentative picture can now be drawn of the ways of life of this mysterious people.

Construction of the large mounds, the surrounding earthworks and the hundreds of smaller mounds, he says, clearly required a dense population and a well coördinated society. This population must have had some stable economic basis. Even though direct evidence of maize is lacking, the practice of extensive agriculture must be admitted, because it alone could have supported the large population aggregates in which the Hopewell people obviously lived.

"There must also have been conscription of labor to construct mounds, which are 30 feet high, 150 feet wide, and more than 200 feet long. To obtain obsidian from the Rocky Mountains, mica from the southern Appalachians, copper from Wisconsin, and amphibians and fishes from the Gulf of Mexico, required time for exploration Since most of the large mounds were built to cover the bodies of the dead, accompanied by their personal adornments and other objects, one can postulate a well-developed ritual, associated perhaps with a remarkable religious fervor If a select ruling class existed, they dominated a very large portion of the Mississippi Valley Copper head ornaments and colored woven garments decorated with fresh-water pearls and mica suggest insignia of authority. At least persons with such attire would be set apart from the rest."

This strange civilization, Mr. Setzler believes, resulted from the impact of two peoples, probably without definite conquest by either. A survey of the field shows the same culture, but in a simpler form, in the lower Mississippi Valley and around the Gulf coast.

No clue has yet been uncovered which permits the dating of this development more closely than sometime between the beginning of the Christian era and the coming of Columbus There certainly were no Hopewellians left when the first white hunters and traders came into the Ohio Valley, for not a single artifact of European origin ever has been found in the mounds. In fact, the country was then inhabited by woodland Indians who had no memory of their predecessors, or even legends concerning them.

No evidence has been found which would indicate that any great catastrophe overtook the people The whole civilization seems to have faded into extinction for as yet unexplained reasons

EXAGGERATED

BECAUSE Cro-magnon man had a very large brain, he sometimes is glorified as our mental superior From a study of his art, W H Riddell, in *Antiquity*, deduces that these Old Stone Age people, with 150 centuries less history behind them than we, had minds equal to those of a bright modern boy of 11 or 12 years

The great stone grave is 11 feet long, six feet wide, and contains approximately 15,000 pounds of dry-wall masonry. Its slab top had caved in

What Makes An Aviator?

Intelligence, Adaptability, Physique, Mental and Physical Health Are Factors

JOSEPH G. LEVINE
Captain, Medical Reserve, Flight Surgeon U S Army

WHEN the question "What makes an aviator?" was put to a leading pilot, he waved aside the idea that any special genius was his or contributed in any way to the making of any flier. "I think that, in the future," he said, "anyone who can drive an automobile or motorcycle safely and efficiently ought to be able to fly an airplane in safety Of course, in flying military, transport, and mail planes, perhaps something more is needed, but I do not think the idea that it takes an unusual man to fly is at all sound." Asked to name definite qualities necessary, he stressed particularly mechanical judgment "It is the meticulous care concerning route and meteorology, and the intelligent handling of mechanical equipment that determines the pilot's length of usefulness in the air."

An experienced army flight surgeon often gets a "hunch" from his first glance at a prospective pilot and may predict to himself, as he follows the student through his training, what kind of flier he will become.

Of course the physical constitution of the flier must reveal no defects in all the essentials The physical examination must be exacting, and is most difficult to pass; for he is subjected to extremes in flying. There can be no history of epilepsy, syphilis, respiratory disease, kidney disease, or any other ailment that may tend to be chronic and recur. The heart, lungs, and nervous system must be sound and free from any defect. Often it is necessary for the military pilot to change direction suddenly at terrific speed. This may cause abdominal pooling of blood and brain anemia in those having a faulty circulatory system, with the possibility that the ship might be out of control long enough for an unexplained crash to follow.

The eyes should be perfect or rendered so by a slight lens correction. There can be no color blindness, for keen vision is essential in determining terrain for landing, night flying, bombing, and in distinguishing military objectives at high altitudes. The glare of the sun from desert, water, and snow, rapid variations in oxygen tension, extremes in temperature and weather; and the roar of the motor all tend to aggravate any weak condition in the near-well individual and may even affect the normal pilot This stress is tremendously increased during wartime flying

Flying has a significant effect on the middle and inner ear The magnitude of the ear problem in aviation may be judged from the fact that pilots suffer more frequently from disturbances of this organ than from all other occupational diseases combined. The conditions of flight which most affect the ear are changes of atmospheric pressure during ascent and descent, noise, and possibly vibration. It has been pointed out that, at the present time, the atmospheric pressure factor is increasing in importance as a result of the increased climbing ability of modern aircraft, while the two latter conditions are decreasing in importance as a result of recent advances in aircraft design

Pilot operating the device that determines perception of depth

Test of pilot with equipment simulating different altitudes

From experience, it is known that certain types of physique may make for better fliers Medically speaking, man is divided into three classes the asthenic, athletic, and pyknic, or obese Just as an external detail can betray subtle changes hidden deeply in the central nervous system, so may facial patterns and bodily conformations serve to guide the examiner in drawing up his estimate of the applicant's constitutional capacity Asthenic, in this sense, does not mean frail but rather the lean and wiry type.

Most of the excellent fliers are known to come from the athletic group This group consistently supplies the first-grade pilots that cannot be surpassed by those of any other nation in the world

Yet it is observed that some of the superlative fliers are derived from the asthenic group The more active glands of internal secretion of the man in this group perhaps speed up his metabolism or body processes His reflexes and power of quick co-ordination are of the hair-trigger variety He is often proficient in all sports where nicety of judgment, finesse, and polished skill are required He may turn out to be a crack pilot just because he is a crank for perfection

Men of the pyknic type are rather unsatisfactory Their excess poundage is the visible sign of slower reflex activity. Many of them may become good pilots, but, as a general rule—to which there are exceptions—they do not make top-notch fliers In emergencies they do not tend to do the right thing instinctively. It is not a question

Official photograph U S Army Air Corps
Phorometer examination by Lieut. Col. A. W Smith, for 20 years flight surgeon and pilot

of intelligence or courage Flying is usually not the field where they excel, though they do succeed in many professions

It has been brought out that many American pilots are descended from the Nordic race group It so happens that pilots from this group are excellent aviators and are second to none of the other race groupings The Nordic comes from a cold climate He is blond, blue-eyed, and of athletic build as usually seen in the air service There is often a piercing quality about his eyes, sometimes referred to indulgently as "eagle eye" That calm, hard, steady gaze is a quality of psychological import He usually conducts himself modestly but confidently, is emotionally stable, intelligent, self-reliant, and of the "he-man" type

The remainder, or minority, of the aviators are drawn from the Alpine and Mediterranean racial groups, and an occasional one from other groupings Their fitness for aviation varies, though not always as we imagine For example, Courtney states "A common notion abroad is that Japanese are poor fliers because 'they have no sense of balance, because their nervous reflexes are too slow'" But a Japanese army flight surgeon reminded him that most of the balancing acts we used to see in vaudeville were given by Japanese "In fact," the surgeon said, "we are endowed with certain racial virtues advantageous to flying We are small and used to cramped quarters We are agile, deft, strong Our greatest difficulty is neither mental nor emotional, but defective vision, which is a national problem"

It would be rather unfair to conclude which racial group makes the better fliers Indeed, it is not likely that Nature has made any particular geographical belt the breeding ground for birdmen The flying type is perhaps evenly divided among them all. What is needed is the soil or opportunities of education and proper flying training to develop them

Military aviation is the field primarily for the young man The most suitable ages are between 20 and 30, preferably around 24 When one has learned to fly in youth, then, with the constant increase of flying experience, he can safely carry on to middle age Flying has become a reflex act with him now, and continued experience compensates for the gradual deterioration that comes with age Of course, when any factor develops that impairs his powers of co-ordination, it is then that he should wisely withdraw The man in civil life, who learns to fly at the age of 30 or later, learns with the same difficulty as one would who takes up swimming at that period He is more easily fatigued and must be given his flying instruction in small doses His knowledge and aptitude in the later years tend toward the synthetic variety

The pilot-selecting process, from the viewpoint of personality study, is of great importance The only son, who has been pampered by his fond parents, must always be the center of attraction to be happy During flying training, he may not do well because of the discipline, and may not get along with his fellow fliers On the other hand, the young man who has been educated in the school of hard knocks and perhaps has been the leader of his gang as a boy, is to be looked on approvingly Extraneous worries, which have to be probed for, are responsible for a number of failures It is by searching into his past life and learning how the student pilot conducts himself in all situations that one can foretell with any degree of certainty how he will act in the future

In selecting the finished pilot for wartime activity, the temperament of the aviator is taken into consideration For pursuit or attack aviation, the flier must be aggressive, with calculated, reckless daring and a flair for action with an enemy In bombardment aviation, the more deliberate and calmly courageous pilot is chosen He must fly level over his objective for a definite period in order to drop his bombs accurately, despite the anti-aircraft shells that are exploding perilously close and the enemy pursuit planes that are on his tail.

Flying skill is always influenced by the degree of conscious fear that is disturbing one's judgment The pilot is always pitting his skill against the elements, and, in wartime, against his enemies It is this constant combat, this game or risk, that is the exhilarating recompense to those who become accomplished aviators Eternal vigilance is the price necessary for him who invades the realm of the eagle

A very definite type of young man is cut out for military aviation, just as in any other line of endeavor The inherited qualities of the mind, tempered by education and experience, with the sum-total of studied foresight and precaution determine the true flying type

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50,000 AIRPLANES

How We Can Build Planes at a Rate of 20,000 a Year

IT is not yet settled whether the airplane can beat the battleship, but it seems definitely settled that air supremacy means winning a war whether on land or sea Colonel Lindbergh and Winston Churchill were right when they warned the nations that German aviation was superior to military aviation of all other nations and that this constituted a menace to the world at large The President is right when he asks for 50,000 airplanes for our national defense, and advises building 20,000 military and naval aircraft in one year

But can we build 20,000 airplanes a year, even with our vast industrial resources? Yes, provided Army and Navy methods of selecting prototypes and placing production orders are greatly simplified and accelerated; Army and Navy methods of inspection and approval are simplified and accelerated; Our trade schools, vocational high schools, and other schools make a great effort to train vast numbers of mechanics, Our trade unions remove their restrictions on the number of apprentices or other means of entry of new men, Our trade unions co-operate in speeding up the national effort of defense; Our universities train

the engineers that will be required in great numbers, The Allied commissions immediately impart all their war-gained information to our Air Services, Our Chief of Air Corps and our Chief of the Bureau of Aeronautics use the dictator's methods in boldly selecting certain types, and in boldly concentrating on those types, and in making up their minds quickly to guide the aviation industry, Our constructors, with permission of military and naval authorities, follow the German plan of building planes and engines which will last 100 hours instead of 5000 hours because the war-time life of a plane is far shorter than the peace-time life of an airplane—we must maintain performance, maneuverability, and gun fire at the sacrifice of durability

The nation as a whole must willingly shoulder the cost of this program Congress should appoint a special aviation committee to function energetically and rapidly, and undertake no super-critical investigations It is better to arm in the air, with mistakes, than not to arm at all

Our young men must seize the opportunities now being offered for flight training, remembering that the pilots are the decisive factors in modern warfare and that it is somewhat pleasanter to be in the dive bomber than to receive its blasts on the march

Above all, those concerned must remember that a co-operative, energetic spirit is imperative Difficulties of production, subcontracting, machine tools, materials, engine bottlenecks, and all other difficulties will vanish provided the people of the United States, Congress, Army and Navy, and manufacturers, all understand that a stupendous effort is necessary —*A K*

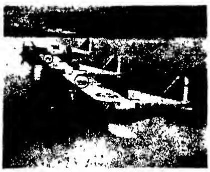
CAMERA GUNS

Two Types Permit Economical Aerial Gunnery Practice

WITH the greatly increased speeds of modern military aircraft, aerial gunnery has become increasingly difficult The difficulties are apparent when one considers that both target and the firing platform not only move at tremendous speeds but also indulge in violent maneuvers. Accordingly, our own air services and the air services of other countries are more and more resorting to training with the camera machine gun To H. K Yulke of *Fairchild Aviation News* we are indebted for an account of this interesting equipment

Two types of camera machine guns are now in use, one for fixed installations and the other for movable installation The movable camera gun simulates as closely as possible the weight, size, appearance, and method of manipulation of the regulation Browning or Colt aircraft machine guns The fixed camera gun is operated like the ordinary fixed machine gun, but bears no similarity to a real ma-

Above: Fixed type camera gun, and, below, cameras (in circles) mounted on upper plane wings



chine gun, it is mounted above the wing, near the leading edge.

Some 4000 Fairchild camera guns are used throughout the world, and their development over a long number of years has been a matter of very skilled technique Loading the film takes but an instant and is extremely easy, it is impossible to load incorrectly. In actual operation there is a maximum of simplicity. The camera starts to operate as soon as the trigger is held down The methods of trigger control are exactly the same as in real machine guns — by pressure of the thumb in the case of the flexible gun and by hand-grip pressure on the trigger switch attached to the airplane control stick in the case of the fixed gun.

A rotary disk shutter is employed and a small glass plate, on which are engraved the concentric circles of the reticle system, is located between the shutter and the focal plane. Each film magazine has a capacity of 25 feet of 16-milli-

Film frame from camera gun

meter film, sufficient for 700 shots or exposures The recording mechanism consists of a split-second watch and celluloid data card mounted on a removable panel, and four small incandescent lamps for illuminating the watch and data card at the instant of exposure Motive power for operation of the shutter tripping mechanism is provided by means of a strong spring

In the reproduced enlargement of a single film frame, taken during a violent mock combat, it is quite clear that the attacking plane from which this picture was taken was in a steep dive upon the target plane —*A K*

CRASH TRUCKS

Pick Up Aircraft After Crashes or Forced Landings

A NEW and unusual type of crash truck is being built for the Air Corps by The Corbitt Company. These units are to be used in salvaging aircraft that have made forced landings on ground from which they are unable to take off, or aircraft that have crashed They are believed to be the largest of the type in the world, consisting of a 198-horsepower tractor unit equipped with crane and hydraulic jack, and a trailer 55 feet in length The capacity is 15 tons

At the scene of operations, the tractor is unhitched from the trailer and then moves around to the side to lift the plane aboard the trailer by means of its crane and hydraulic jack If the plane is in soft ground, the tractor may stand on hard ground some distance away and pull the trailer in toward it by means of winches

The transmission has five speeds forward and one in reverse in two ranges, thus giving a total of ten speeds forward and two in reverse Furthermore, the tractors are six-wheel drive

Is Your Pet Dentifrice Safe?

Most Dentifrices Are Good but Many of the Claims Made Are Not Justified

ALBERT G. INGALLS

FEW of us accept the daily war communiques literally Most of us discount their obvious untruths and exaggerations, if any, and mentally fill in omissions where we think they are not altogether frank Even though their writers should wish to do so, they find they cannot stick to prosaic fact, because the competition is so intense They discover also that the calculated inaccuracies are accepted by at least some of the people

In the long-standing "war" of trade between makers of dentifrices the competition also is intense Some of these makers similarly have discovered that not all of the public appreciates frankness Even the intelligentsia aren't always too intelligent when it comes to evaluating claims for merchandise Therefore, not all the claims for dentifrices have been altogether frank, either

This is not, however, one more "awful grievance" article, since most of the nationally known dentifrices are safe Sometimes—generally, in fact—the grievance lies only in the extravagant claims made for the dentifrice

Just what can a safe dentifrice reasonably be expected to do? First, what are some of the things it cannot do?

No dentifrice, safely or otherwise, can keep the mouth germ-free If it could kill the germs it would damage the mucous membranes of the mouth, and even if it could kill the germs without this damage, its effect would be transitory because the saliva would soon wash it away and more germs would come in Besides, we are not as frightened about germs as we used to be

Similarly, dentifrices cannot prevent acid mouth, because their effect is so transitory Moreover, it is entirely normal for the human mouth to be acid Just a matter of physiology

No dentifrice can prevent tooth decay Even after an immense amount of research, science has not fully reached the answer to the question of the cause of decay in teeth, but present indications point strongly toward something related to the diet The immediate cause, however, is the chemical action of acids on the teeth These acids form at inaccessible places in the teeth—most often between the very close, tight folds in the chewing faces—through the work of microorganisms on foods Brushing the teeth may help, but even brushing them with the best dentifrices cannot stop decay, since it does not remove the cause

Nor can any dentifrice prevent, competently treat, or cure pyorrhea This is a job for a dental surgeon—often a difficult job at that

HALITOSIS! Bad breath How can a dentifrice competently treat this? It is caused sometimes by stomach disorders, sometimes by nasal or sinus disorders, infected tonsils, decayed teeth or other diseases, and is therefore only a symptom, not a disease Treating halitosis with a dentifrice is therefore merely "treating the symptom," something the old doctor tells the young doctor never to do Of course, a dentifrice that would really cover up halitosis even if it did nothing else, would be a real boon to the world—almost as great as would have been Vice-President-Marshall's famous good five-cent-cigar—if only it would last more than a brief time after its use

Really insidious are claims for tooth whiteners, since these preparations contain acids — hydrochloric acid, for example Nor will they always whiten teeth, since some teeth never were white to begin with Teeth vary in hue just as complexions do, and just as naturally

Massaging the gums with dentifrices may do a limited amount of good, since it stimulates the circulation, but it is the massaging that does the good This is not, however, a fully competent treatment for hardening the gums

Use powders because your dentist does! This sounds logical but dentists do not use powders because of any inherent superiority due to their dry form In fact, the dentist makes a paste of the powder he uses, by first wetting it Toothpastes also contain powder Dentifrices are put up in paste form, generally with glycerine as the carrying liquid, because this is the form in which the public can most conveniently use them This is not to argue against tooth powders but only against some of the claims made for them

Dentists deny that the glycerine in toothpastes softens the gums, as some makers of powdered dentifrices have said Concentrated glycerine is, of course, always thirsty it seeks water (is "hygroscopic") and will take it wherever it can get it, but the small amounts used in brushing the teeth are not considered by dental authorities to be a menace or a danger The argument, therefore, that glycerine softens the gums is empty

Having subtracted these main items from the total that have been claimed for dentifrices, what real values are left?

To begin with, the toothbrush itself is the most valuable factor in mouth hygiene The dentifrice is its junior assistant Most dentifrices contain two principal ingredients designed thus to assist one is soap, or a soap substitute The other is an abrasive. Abrasives must be mild, and not as hard as the teeth A third and liquid ingredient, often glycerine, acts as a vehicle, as previously described, and a flavoring agent, the fourth, helps make us want to brush our teeth when we feel lazy, as most of us often do

Soap and abrasive — together these do a lot, but a dentifrice won't cure spavins Makers who claim little more than that dentifrices help cleanse the teeth—and there are some who do—hit closest to the simple truth, and for this alone a good dentifrice is more than worth to us what we pay for it

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BLEEDERS

New Substance Clots Blood Instantly

BLEEDERS, from new-born babies to patients on the operating table and even, in many cases, hemo-

philiacs suffering from the hereditary bleeding disease, can now be saved by two death-defeating substances presented by Dr H P Smith, State University of Iowa

One of the anti-bleeding substances is a new preparation so powerful that, when sprinkled on a wound, it stops bleeding by clotting the blood "in the twinkling of an eye" It is obtained from beef blood This material is so fast in action that it will clot blood in one second It is not yet on the market and the supply is still limited but surgeons at the University of Iowa have already used it, with "quite encouraging" results, to stop dangerous oozing of blood during major operations This oozing, which is difficult if not impossible to stop by other methods, is especially troublesome in operations on the brain, liver, and bone When the material is available generally, dentists will also be able to use it to stop bleeding after teeth are drawn For hemophiliacs, such as the Spanish Count of Covadonga, who recently bled to death from injuries following an automobile accident, the new thrombin may prove life-saving

Thousands of new-born babies and older patients suffering from obstructive jaundice can be saved from bleeding to death by the other substance which Dr Smith discussed—vitamin K This vitamin not only stops bleeding but, if used properly, will prevent the bleeding, Dr Smith emphasized The vitamin was discovered by Prof H Dam of Copenhagen Its chemical identity was determined and it was prepared synthetically by scientists at the St Louis University and the University of California It was first used to treat patients by Dr Smith and by doctors at the Mayo Clinic —*Science Service*

THEELIN

To Speed Knitting of Broken Bones

Knitting of broken bones, especially in elderly women, may be speeded by treatment with the female sex hormone, theelin, Dr G A Pollock, of the Mayo Foundation, declares as a result of studies of the effects of theelin on broken bones in laboratory animals.

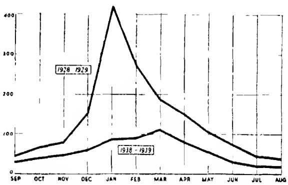
Women over 60 years of age get so-called "broken hips" with "striking" frequency, Dr Pollock points out. The condition, although popularly known as a "broken hip," is actually not a break of the hip but of the neck of the thigh bone near where it is joined to the hip A change in the bones of older women suggested a relation to the cessation of ovarian function in women past 50 years Several other scientists, Dr Pollock found, had also noted a relation between female sex hormones and bone formation —*Science Service*

LICKED?

New Drugs and Methods "Encircle" Pneumonia Germ

If 1938 and 1939 can be taken as representative of an established situation, the pneumonia season—winter—has suddenly lost much of its dread, according to data assembled by the Metropolitan Life Insurance Company New serums, sulfapyridine and allied drugs, have abruptly cut the winter peak mortality from pneumonia to about a quarter of what it was —as the accompanying graph shows

"Certainly," says the company named, "the experience of these last two years augurs well for the future We have good reason to be optimistic, in the light of the new methods for pneumonia treatment now being rapidly extended to all parts of the country Just a short time ago serum therapy was used in only a few cities and states But now the advantages of serum are generally known and applied Perhaps even greater successes may be expected from the recent advances in chemotherapy The full possibilities and limitations of the new drugs have not yet been defined, but the use of sulfapyridine and allied drugs has already yielded most gratifying results It may be that the most efficient form of treatment will be found to combine sulfapyridine and serum"



Comparison of pneumonia mortality cycles

BRAIN WAVES

Practical Uses for Laboratory Discovery Steadily Increase

Broadened use of brain-wave detection already has aided surgery, anatomy, and physiology, according to Dr Ralph W Gerard, associate professor of physiology of the University of Chicago

The noted neurophysiologist and pioneer in the study of brain waves —tiny electrical currents continuously emitted by the brain—enumerated recent advances through brain-wave study Detection of brain-wave irregularities aids diagnosing and locating brain tumors It makes possible, too, the detection of epilepsy in its first stages The anatomist can detect the nerve tracts which carry stimuli from various parts of the body to the brain, while the physiologist attempts to find out the why and how of brain waves, and has at least partly succeeded

Recent research on brain waves has revealed that the temperature of the brain cells increases the rate of their electrical rhythm, possibly with some bearing on the use of artificial fever in treating insanity that sedative and anesthetic drugs producing sleep slow the rhythm, while caffeine steps up the waves to more than ten times their normal size

BLOOD RAYING

Infected Blood Now Taken Out, "Sun"-rayed, Put Back

Blood poisoning and some other infections are being treated by removing some of the patient's blood giving it a quick treatment with ultra-violet rays, and returning it to the body at once Dr George Miley, Philadelphia physician, recently announced the method's success

This is not in itself a new treatment but one that previously failed the rays did not reach clear through the blood treated. Success resulted when a system of baffles kept the blood turbulently turning over

Why Universal Fingerprinting?

Desirable Features of System Far Outweigh Erroneously Imagined Criminal Aspects

FREDERICK KUHNE

Former Sergeant, Bureau of Identification Police Department, City of New York Author of "The Finger Print Instructor"

THERE are only two reasons why anyone should object to the enforcement of a universal fingerprint law Either he wishes to cover up some past wrong-doing, or he is afraid that sometime in the future he may be guilty of a violation of law In either case he knows that registered fingerprints could well be the means of bringing him to justice

On the other hand, every honest and upright person, citizen and alien alike, should welcome a universal fingerprint law Through its enforcement would come many personal as well as national advantages, the most important of which are outlined in the following paragraphs When these advantages are fully appreciated, there should be little opposition to universal fingerprinting, indeed, there should be increased demand that such a system be inaugurated with a minimum time loss

It is undeniable that much of the popular opinion against universal fingerprinting arises from the erroneous impression that fingerprinting is indelibly linked with crime That it has been of tremendous value to law enforcement officers in connection with criminal cases is, of course, true But it must not be overlooked that the lessons learned in this work can be and have been applied in non-criminal work to the great benefit of the honest private person Fingerprinting, proved an infallible system for establishing identity, has made possible positive identification of amnesia victims, unknown dead, missing persons, and so on And who can foresee when some accident, some unpredictable event, will make such identification desirable in his own case?

Fingerprinting of all military forces during World War I, plus the voluntary filing of several thousands of prints in the Civil Division of the F B I, has done much to lessen public objection to the system There is still a large majority of residents of the United States, however, who feel that compulsory registration of fingerprints would violate their constitutional rights Hence the following summary of some of the favorable aspects of universal fingerprinting and recording under government control

Such a system would do away with the present expensive method of taking the census every ten years The records would give a continuously corrected census of the nation, divided by states, counties, cities, towns, and villages

Persistency of fingerprint ridges is demonstrated by these two prints· one at left was taken in 1892; one at the right in 1922

It would also give a complete record and control of the movements of all persons in the United States, whether resident or entering or leaving It would prevent the deported from re-entering and the fugitive from leaving the country It would prevent the falsification or forging of passports and would serve as a deterrent to other infractions of the law

With universal fingerprinting in force, any national emergency could be met with little loss of time The records would make possible a speedy call to arms and would prevent draft dodging Furthermore, those in authority would be able to compile records showing the exact numerical strength of every classification of persons, together with ages, occupations, and other important information

Record files of a universal fingerprinting system would be of great value to the post office From them could be obtained correct addresses for improperly addressed mail, thus materially reducing the amount of mail sent to the dead letter office and hence reducing the cost of maintaining this office

Civil service applications could be acted upon with speed and accuracy from the data supplied by fingerprint files. With this information available, it could be definitely known at all times that only honest persons would secure appointments to this important service

Couple the foregoing with the more obvious applications of universal fingerprinting to the curtailment of criminal operations and we find a multitude of favorable reasons as against the few and erroneously conceived unfavorable reasons

Establishment of a universal fingerprinting bureau might appear to be a gigantic proposition It would be, however, an undertaking no greater than our present system of handling the mails, and the cost would be negligible Post offices, which are equipped to serve every resident of the United States, could be used as headquarters for fingerprinting those who reside within each postal district Thus there would be no additional expense incurred so far as office space is concerned and the money saved, by abolishing some of the present activities which would no longer be necessary under universal fingerprinting, would more than pay for the additional help required to handle the routine of fingerprinting

THE system of enforcing universal fingerprinting could be worked out through the post offices in somewhat the following manner All present residents would be required to report within a specified time to their local post offices. Here two sets of fingerprints would be taken, one to be forwarded to a central bureau at Washington, D. C. and the other to remain on file in the district post office. When a resident moves out of a postal district, it would be compulsory for him to notify the postmaster to this effect, giving the date of his removal and the address to which he is moving. Upon receipt of such notification the postmaster would then enter such changes on the fingerprint record and would also notify the central office. If a resident is to move to some other point within the same postal district, the duplicate print would remain in

the local office. If, however, the new address is within another postal district, the print would be forwarded to the postmaster of the new district so that the record would be complete at all times.

Of course, it would be a necessary part of a universal fingerprint law that each resident of the nation should be required to carry an identification card containing appropriate data This card should also bear a simultaneous plain impression of the right index, middle, and ring fingers, similar to those now used by banks and the postal savings department

Thus it will be seen that a universal fingerprinting system could well be established in the United States with a minimum of expense and a maximum of desirable results The advantages that would accrue to the average resident would, indeed, far outweigh any residual feeling that he might have regarding the criminal taint of fingerprinting, particularly so when he realizes that this taint is one that should long since have been discarded as having no foundation in fact.

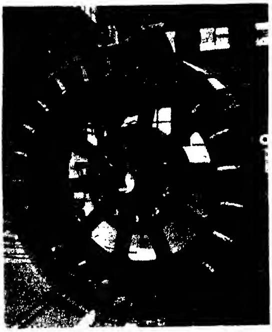
● ● ●

HEALTHIER PLANTS

Vitamin-Hormone Stimulant in Powder Form

FROM the Horticultural Department of the American Chemical Paint Company comes news of the commercial production of a vitamin-hormone stimulant, Transplantone, for plants, that not only invigorates old roots but also multiplies the production of new ones, reduces the loss which frequently occurs with transplanting operations, and reduces wilting It is applied to rooted plants to add to existing root growth and to force their general growth.

Transplantone is a water-soluble powder impregnated with Vitamin B-1 and other parts of the Vitamin B fraction, plus root-promoting hormones. The hormone initiates root growth and plant physiologists assert that the Vitamin B chemicals are necessary for the maintenance of their growth That it is quite concentrated is obvious for it requires only one level teaspoonful to a gallon of water to make a stock solution which is then further diluted. Seedlings may be lightly sprinkled weekly, or it may be applied to plants set out in the soil, whether they be trees, shrubs,



Engine vibration in marine installations is not transmitted to the ship's propeller when this new type of electric coupling is used Built by Westinghouse, the coupling consists of an armature connected solidly to the engine shaft and a field connected to the gears that turn the propeller. These two rotating parts are separated by a small air gap; when the armature is rotated by the engine, magnetic forces are set up which turn the field (shown at left) and hence turn the propeller shaft of the ship

vines, annuals, or perennials In the case of plants which are set out without a ball of earth, the manufacturer recommends that the roots be soaked in the stock solution for an hour Treatment usually results in vigorous and extensive root growth and this, in turn, requires more frequent watering than is ordinarily necessary

The manufacturer further claims that, owing to frequent clipping, grass is unable to produce enough vitamin and hormone naturally for the roots and that watering with an ounce of stock solution to three quarts of water will improve turf quality Sods similarly treated before being set in place will also readily form new roots —*C F Greeves-Carpenter*

HEROIC CASTING

Largest Ever Cast in Stainless Steel

A BRIGHT new symbol of America's free press, the first heroic sculpture cast in stainless steel, was unveiled recently on the facade of the Associated Press Building by Nelson Rockefeller, before a distinguished assemblage Kent Cooper received it for the Associated Press

This 10-ton plaque of bright metal was made from the winning design in the Rockefeller Center-Associated Press open competition for a sculpture symbolizing news and the press Its designer was sculptor Isamu Noguchi

The 23-foot by 18-foot model, sculptured by Noguchi in plaster, was but a beginning for eight months of labor by engineers, metallurgists, molders, machinists, and polishers who blazed new trails in perfecting the technique that made possible the jump from a few hundred pounds, the largest preceding art work cast in stainless steel, to this titanic 10-ton bas-relief

Completion of this panel marks several "firsts" in the artistic, architectural, and metallurgical fields Noguchi is the first American artist to use cast stainless steel as a sculptural medium, and the Rockefeller Center architects are the first to demonstrate the use of a light-reflecting metal to replace the traditional light-absorbing stone and metal decorations of buildings The General Alloys Company, pioneers in stainless steel, solved many technical problems involved in casting this panel which is twenty times larger than any previously cast The work involved the engineering of special equipment, the development of synthetic sands to withstand the terrific heat of the molten metal, and powerful precision grinding machines to achieve "invisible" joints in the finished plaque

FLOOR SEALER

Finish Penetrates Wood Grain, Gives Protection

AN attractive and durable finish for unfinished floors has been put on the market by American Asphalt Paint Company. The manufacturer claims that it furnishes absolute protection against dirt, water, grease, and constant wear.

Through its active penetration into the wood, this new finish, which is called Valdura Floor Sealer, seals the grain and gives a waxed and polished appearance, with no surface coating to wear off. Therefore, floors finished with it are said to retain their original color, or natural wood finish

Valdura Floor Sealer can be applied with a mop or a brush One coat only is needed, and one gallon covers about 800 square feet of floor surface Three or four hours drying time is all that is necessary before the floors are subjected to foot traffic The sealer may also be used to advantage on logs, knotty pine, creamery churns, and other unfinished wood

BATTERY CONDITION

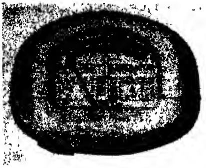
Indicator Shows When Battery May Fail

To protect car owners against the yearly toll of battery failures due to overcharge or undercharge, an accurate, dependable "battery condition indicator" has now been refined and made available for use on the dash of any automobile as an accessory

This new instrument — called Charge-Master — indicates to the car driver the state of charge of his battery when at rest When the generator is charging, the instrument shows promptly any variation in battery charge, in generator performance, and in load (such as radio, heater, and so on) on the electrical line It shows overcharge and undercharge — each of which may shorten the life of the battery and, if pronounced or continued over a long period of time, may disable it beyond repair

Charge-Master installs on any car, bus, or truck in about 10 min-

Arrow points to battery condition indicator on motor-car dash



For storage battery protection

utes The wiring is simple The instrument is self-illuminating whenever the dash lights are turned on

Car owners too often have unfairly blamed good batteries and good service men for sudden battery failures and repair costs due to heretofore unindicated overcharge or undercharge This new device lays the blame where it should be, tells when to turn on or turn off the electrical load from radio, heater, lights, and other equipment in order to hold line potential and battery charge within safe limits until a preferred service man can be reached for timely preventive service

DUST MASK

In an attempt to provide adequate protection against air-borne dusts, pollen, or certain bacteria which annually cause untold suffering and the loss of millions of dollars, an American Optical Company research scientist — W H Lehmberg — has designed an exceptionally light and efficient filtering device for wearing over the nose and mouth to protect the respiratory system

Weighing only an ounce and a half, and excluding particles of dust as small as a micron — 1/25,000 of an inch — the device was developed to give comfortable protection to those working in dusts, persons allergic to pollens causing hay fever or asthma, and doctors, nurses, and patients exposed to certain air-borne bacteria

The high filtering efficiency of the new respirator is actually needed, because silica dust now generally considered harmful to the lungs is approximately five microns or less in size, common pollen grains which cause hay fever and asthma range in size from 10 to 100 microns, and bacteria are approximately one micron.

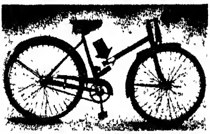
The effectiveness of the new mask, which is lighter than any

other of equal efficiency, is due to four factors· A new method of making the filter unit, resulting in an extremely large, efficient filter area for the size of the mask, a new and efficient exhalation value, a new self-equalizing double head-band which holds the mask securely but comfortably against the face regardless of the position of the head, and a facial design that enables one to wear the device with perfect comfort

FOLDING BICYCLE

For Ease in Carrying

THOSE of us who were growing up in the days before the automobile era may wish that when we were young there had been available a folding bicycle such as the Compax Sports Traveler recently announced by the Westfield Manufacturing Company Not only may this bicycle be taken apart in 15 seconds without the use of tools, but, because it has no top-cross bar, the one model fits adults and juveniles of both sexes Because of its compactness when folded up, it can be carried conveniently in automobiles, busses, trains, and



Simple joints for folding

other conveyances That is an important advantage in these days when many people must travel to the country for their cycling

The single cross bar of this bicycle, running from just beneath the handle bars to a point on the rear half just above the sprocket, has a slip joint with a single nut for tightening The machine breaks apart at this point so that the two wheels may be folded together while the handle bars will swing downward for greater compactness

PEEP-SIGHT

Gives One-Way View Through Front Door

ALARMED by the appalling growth of attacks on housewives by criminals who ring doorbells and force their way inside when the door is opened, police throughout the country are warning women and all householders in urban areas to be on constant guard against this menace

Various protective methods, such as doorchains and special latches have been suggested, but a very

Protection for the housewife

effective new device is an ingenious affair called the "Protective Eye"

This safety device takes the form of a handsome and entirely innocent appearing door-knocker In its center is hidden a bulls-eye of "one-way glass," making a tiny window which enables the housewife to look out and see any caller without that person being aware of the inspection Having surveyed the caller, she can refuse to answer the summons or open the door as her judgment dictates

The secret of the "Protective Eye" lies not only in the inconspicuousness of the glass but in the fact that it has one-way vision That is, you can see outside from the inside, but not inside from the outside.

TREE PROTECTION

Spray Coat Reduces Dehydration

A NEW tree spray called Protex is being offered by Protex Industries, Inc It was first successfully used at the New York World's Fair, and officials praise it highly as a spray to reduce dehydration and obviate excessive pruning It does not wash off the tree and prevents excessive transpiration without restricting respiration. The makers recommend Protex as being superior to burlap, straw, or other wrappings in extreme temperatures In addition to a winter Protex, a summer consistency is also available and is designed to prevent sun scald or scorch. The product is a rubber compound and forms an elastic coating that reflects the rays of the sun, thereby preventing wide extremes of temperature.—*American Forests*

WOOD STOVE

New Principle Achieves 90 Percent Efficiency

DEVELOPMENT of a new type wood burning stove, capable of heating two or three rooms and requiring filling only once or twice a day, is regarded by New England foresters as bringing new hope to farm woodlots which have long suffered for lack of a suitable market for cordwood

The new stove, developed by the Connecticut Forest and Park Association in co-operation with Prof Lauren E Seeley, Yale heating expert, burns wood at an estimated 90 percent efficiency. Because of a radically new design, the heater operates on the principle of "destructive distillation," burning both gas and charcoal formed in its operation

A cord of hardwood has fuel value approximately equal to that of a ton of hard coal. The heater, shown in our illustration, will hold about two and one-quarter cubic feet of wood, or more than 50 pounds Small-diameter trimmings from sawmill operations or from "weeding" the family woodlot are recommended in preference to the larger chunks commonly used in wood stoves As wood is burned in the combustion chamber at the bottom of the stove a fresh supply is dropped automatically from the reservoir above, producing steady

Note the fuel reservoir in this efficient wood burning stove, for homes, garages, and camps

heat for long periods without reloading.

Prof. Seeley estimates that the heater will generate heat sufficient for two or three rooms in cold weather—for an eight-hour period without attention. In mild weather the heater will easily run more than 24 hours without attention — *Science Service*.

GARBAGE GRINDER

A NEW under-the-sink garbage shredder has been developed by the In-Sink-Erator Company. It is designed to eliminate the unsightly and smelly garbage pail, for all garbage is simply dumped into this device and when the motor is

switched on the garbage is so ground that it may be washed down the drain This includes such things as bones and fruit pits

The shredder head on this device, which is powered by a 1/4 horsepower motor, operates alternately in one direction and then in the opposite, so that garbage is cut either into very tiny pieces or pulverized It is connected with the house wiring system and requires during the very short time it operates only about as much power as the average electric iron.

ELECTRICAL HAIR BRUSH

WHILE it is not possible to say definitely whether vigorous brushing of the hair has any great retarding effect on the advancement of baldness, such brushing is often recommended to stimulate the scalp and give tone to the hair For those who believe that stimulation of the scalp does assist natural growth of the hair, the Hershey Manufacturing Company has just developed a power-driven

scalp brush. The several rows of bristles are so driven, at 5000 strokes per minute, that a definite cyclic sequence is maintained.

There is at present a professional model of the Vitabrush, a portable model for home use will soon be available

COTTON WRITING PAPER

DETAILS are as yet unavailable as to the new process for making a high quality writing paper directly from cotton — low-grade cotton, at that — but the development work was done by the U S Department of Agriculture in co-operation with the Writing Paper Manufacturer's Association Provided that the process is a commercial success and paper can be made cheaply enough to create a big demand for it, then this should solve a sizeable part of the problem of what to do with America's surplus cotton

Count Morner and life-saving suit with kapok-wadded vest

LIFE-SAVING SUIT

Seals Up Water-tight and Warm

A LIFE-SAVING suit of a new design has been invented by a Swedish engineer, Count H G Morner The Morner life-saving suit is made of water-proofed fabric, closed in front by a special rubber "zip"-fastener The suit — boots and mittens being all in one — is put on as an overall in less than one minute, the inventor claims, but it is intended to be worn by seamen all the time, although open, while the ship is in a danger zone Its buoyancy is due to a special kapok-wadded waistcoat, sewn into the suit, which keeps the shipwrecked floating, even if there should be a leak in the suit Besides keeping the person afloat, the suit warms him while he is in the water, and it also prevents him from freezing to death if and when he is rescued in lifeboat or raft

Designed for seamen, this life-saving suit is quickly closed by means of a "zip" fastener

ROCK-PILE RESERVOIRS

Ancient People Collected Drinking Water on Rocks

THE British dew ponds described in the *Industrial Bulletin* of June, 1938, were not the only means of extracting water from a moisture-laden, but stingy, atmosphere According to a recent issue of *Discovery*, medieval townsmen of Theodosia, a Black Sea port on the southeast of the Crimea, obtained sufficient water for a flourishing city by erecting, on the near-by heights, great piles of broken stones upon which the moist breezes from the sea would condense some of their water Thirteen of these piles, connected with the city by a system of sandstone pipes, supplied 16,000,000 gallons of fresh water daily and permitted Theodosia to become the most important port on the north coast of the Black Sea

Barbaric conquerors permitted the stone piles to become overgrown with vegetation, which destroyed their effectiveness It was

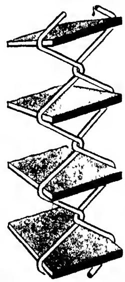
not until the later nineteenth century that the purpose of the piles was again learned and efforts made to restore them to usefulness Modern engineering methods were not, however, immediately successful in duplicating the empirical work of the original builders, one attempt to do so failed and thereafter political conditions prevented further efforts

Successful construction of both dew ponds and stone condensers depends upon secrets which are not yet common knowledge Yet the theory of their operation is simple and a determined effort might cut through the time-fostered traditions of failure Successful operation would bring life to many an arid seacoast locality and to coral islands whose porous substructure will not permit retention of water, even though rainfall is ample —The *Industrial Bulletin* of Arthur D Little, Inc

SCREEN

Dazzle-Damping and Insect-Proof

THE newest thing in window screen materials is something like a miniature Venetian blind Called Koolshade, it is made of horizontal flat strips of bronze, woven together every half inch with vertical



Section of bronze wire-and-strip window screen, enlarged 20x

bronze wires The spacing is the same as in the standard 18-mesh screen and is, therefore, equally insect proof

The horizontal flat strips serve to kill some of the glare of brilliant summer skies, but let in plenty of light horizontally.

Conducted by JACOB DESCHIN, A.R.P.S.

Light Control With an Electric Meter

THE mere purchase of an exposure meter of the photo-electric type, today generally regarded as the most efficient method of light measurement available to the practical photographer, is by no means a guarantee against incorrect exposure—unless the meter is properly used It is not enough merely to point the meter; it must be pointed toward the subject with due regard to the angle at which the meter is held and its distance from the subject Furthermore, many workers fail to take advantage of the various methods by which the photographer may truly obtain the full control of exposure that his meter can provide for him

Beginners usually start off by deciding on the particular subject matter they wish to photograph, pointing the meter in that direction and adjusting the camera settings in accordance with the reading thus obtained What happens" If it is a landscape with beautiful clouds in the background, the foreground is frequently underexposed If it is a portrait, outdoors or indoors, the face is either overexposed or under-exposed, depending on the brightness or darkness of the background

The reason lies in the fact that a camera view encompasses a variety of light intensities, which may range from very dark shadows to very bright highlights, whereas the meter is calibrated at a definite reflection factor Therefore, because the meter encompasses more or less the same area as the camera, when held at the camera position it will take in a great deal of light from the sky, as in a landscape, and much less from the foliage, etc. The result is an "average" measurement that is of no use at all because the light from the sky will be relatively so strong that it will greatly overbalance the light coming from the foreground As a result, the sky reading is favored and underexposure for the landscape proper is bound to result Similarly, in the case of a portrait outdoors, a reading from the camera position will take in the background and surroundings as well

Book was lowered to take a reading of shadow side of face

". . . approaching the subject closely, regardless of camera position . . ."

If these are much brighter than the subject, as in the case of a sky or a sunlit wall, the portrait subject will be under-exposed, if, as in the case of a background of dark foliage, they are less brilliant than the subject, the latter may be over-exposed

Since the objective in light measurement is to obtain a proper reading for the most important part of the subject and to allow the exposure latitude of the film to take care of the rest, it must now be clear that in order to get a well exposed landscape, or portrait, the light reflected from these

Latest in meters

subjects *alone* must be measured This is usually accomplished by tilting the meter slightly, toward the landscape, excluding the sky, in the one instance, and approaching the portrait subject closely enough with the meter, regardless of the camera position, to include within the meter angle only the face of the person being photographed A convenient rule for taking readings of objects at close range is to approach the subject to within a distance equal to the width of the subject

Sometimes, however, it is not possible to approach the subject closely enough for proper reading In such cases, the substitution method of meter measurement is used If there is a tree or a house in the shade across the water that you want to include in a particular view, all you have to do is take a reading from your own clothing or from a tree nearby and use this reading for the exposure

Where it is not possible to obtain a meter reading of the direct reflection from the subject, it is useful to read the incident light, that is, pointing the meter towards the light source itself In the latest meter to appear on the market, General Electric's Type DW-48, provision is made for making readings of this type direct. A self-multiplier is incorporated in the calculator which automatically multiplies exposure when the meter is used for incident light measurement in very dim light. (See "What's New" for fuller description of this meter)

How other electric meters may be calibrated for use in reading incident light is suggested in the following experiences of C. W Gibbs, A.R.P.S.

"In my experiments, I used the Mini Photoscop. This meter is calibrated in American Scheiner figures In my first trials a Kodaflector was set up exactly six feet from the subject Two small flood bulbs were employed The meter was held near the lights The meter reading was 9 This value was jotted down and then a series of exposures was made on Super XX film The films were developed in X33 for the correct time to give a gamma of 7 Upon examination it was found that the exposures were fairly good through a range of from 1/250 at *f*/2 to 1/250 at *f*/5 6 Setting the meter to these exposures and then seeing what film speed was equivalent to a reading of 9 it was found that these exposures would have resulted from a setting of 17 and 26 For normal use, then, we would consider the Super XX to have a speed half way between these two values If the light were dull or if we were compelled to shoot at a higher speed than normal, we could see by setting the film speed to 26 if we would get a good negative or if it would be thin If the latter, we could compensate to some extent by prolonging the development time"

Extreme brightness range such as this requires care in exposure

Any given scene may receive several different exposures, each of which will be considered correct for the result wanted, and this without regard for the general over- or under-exposure of the full image A subject reflects highlights, shadows, and middle tones. If the brightness range is longer than the latitude of the film can take in at once, the worker has a choice of three procedures. He can read the shadows or the highlights or the middle tones and use each reading as a basis for exposure of the whole. The fact that film has a tone range from 1 to 128 is used in a practical way on the dial of the Weston exposure meter Besides an arrow provided for normal readings, there is a letter *U* and an *O* at either end of the indicator scale on the dial. By using this meter to read

Fifth Annual Scientific American

AMATEUR PHOTOGRAPHY CONTEST

OVER $1200 IN PRIZES

IN this year's contest, prints may be entered in any or all of the three groups listed below, in accordance with the rules In addition to the seven major prizes and five honorable mentions, there will be three SPECIAL AWARDS that will be accorded to the three outstanding photographs among the 36 prize winners *These special awards will be given in addition to the regular prizes that the pictures win*

36 PRIZES PLUS Three Special Awards

DIVISIONS IN WHICH PRINTS MAY BE ENTERED

Division 1 Human interest, including camera studies of people, animals, and so on Portraits will be grouped in this division

Division 2 Landscapes, including all scenic views, seascapes, and so on

Division 3 Action, including all types of photographs in which action is the predominating feature

IN EACH OF THESE DIVISIONS THERE WILL BE AWARDED SEVEN MAJOR PRIZES AND FIVE HONORABLE MENTIONS WINNERS OF THESE PRIZES BECOME AUTOMATICALLY ELIGIBLE FOR THE THREE SPECIAL AWARDS

RULES of the CONTEST

1 The groups will be judged independently on the basis of pictorial appeal and technical excellence The decision of the judges will be final In case of a tie for any prize, duplicate prizes will be awarded to the tying contestants
2 Prints must not be smaller than 5 by 7 or larger than 11 by 14 inches All prints must be mounted, otherwise they will be returned immediately
3 Photographs must be packed properly to protect them during transportation
4 Non-winning entries will be returned only if sufficient postage is included when the prints are submitted
5 Each entry must have the following data written on the back of the mount Name and address of contestant, type of camera, and film, enlarger and paper used
6 Contestants may submit no more than two prints in each group, but may enter any or all groups In no case however will more than one award be given to any individual contestant
7 Prints must be in black and white Color photographs are not eligible
8 Prize-winning photographs will become the property of Scientific American, to be used in any manner at the discretion of the publisher
9 Scientific American reserves the right to purchase, at regular rates, any non-winning entry
10 No entries will be considered from professional photographers
11 All entries in this contest must be in the hands of the judges by December 2 1940 Results will be announced in our issue dated February, 1941
12 The contest is open to all residents of the Western Hemisphere who are not in the employ of Scientific American
13 In fairness to all contestants, failure to comply with any of the above rules will result in automatic disqualification

THE PRIZES

1st. Three $125 LONGINES, Coronation Model, Solid Gold, Men's Wrist Watches.

2nd. Three $85 LONGINES, Presentation Model, Solid Gold, Men's Wrist Watches.

3rd. Three FEDERAL No. 246 Photo Enlargers (List Price $49.50).

4th. Three FEDERAL No. 345 Photo Enlargers (List Price $42.50).

5th. Three PIERCE CHRONOGRAPH Men's Wrist Watches (List Price $19.75).

6th. Three BERMAN-MEYERS Flash Guns complete with case (List price $15).

7th. Three FINK-ROSELIEVE Vaporators (List price $12.50)

HONORABLE MENTION

1st. Three Fink-Roselieve "Hi-Spot" Hollywood type spotlights.

2nd. Three Mimosa Perkino developing tanks.

3rd. Three Raygram Wood-Chrome Tripods.

4th. Three Fink-Roselieve Audible Timers.

5th. Three Fink-Roselieve Satin-Chrome Range Finders.

THREE SPECIAL AWARDS!

Winning pictures in the three divisions will be grouped and judged further to determine which three of them shall be considered as the best in the entire contest To the contestants who entered these three photographs will be presented the following special awards

1st. One No. 715 Weston Exposure Meter (List price $24.)
2nd. One No. 650 Weston Exposure Meter (List price $19.95.)
3rd. One No. 850 Weston Exposure Meter (List price $15.50.)

THE JUDGES:

McClelland Barclay, artist
Ivan Dmitri, artist and photographer
T J Maloney, editor of U. S Camera
Robert Yarnall Richie, photographer

Address all Entries to

Photograph Contest Editor, Scientific American

24 West 40th Street New York, N. Y.

the extremes of brightness in a subject and then setting the *U* instead of the "normal" arrow, or the *O*, depending on which end of the subject brightness range is to be favored, a reasonably correct exposure will be obtained that will take advantage of the full scale of the film

A last word You may follow these suggestions and still go wrong However, before you start blaming the meter, ask yourself the following questions

1 Am I using the correct speed rating for the film?

2 Is the shutter working properly?

3 Was the resulting negative correctly developed?

Behind the Speedguns

There is much more to a Speedgun than may appear on the surface, as a visit to the Speedgun Corporation's plant in Bloomfield, New Jersey, has convinced us For one thing, more than 600 separate parts are required for the assembly of the various Speedgun models To produce these, the Speedgun engineers employ 150 special tools, one of which is a tube-cutting machine that not only saves several burring operations in cutting dural and brass tubing, but is capable of slicing two-inch tubing to lengths as short as 10/1000 of an inch The Speedgun engineers design and make their own tools in many instances, thus making the plant independent of outside sources of supply

The development division of the plant, under the supervision of Philip K McGall, inventor of the Microswitch, is carrying on the work begun ten years ago by S Mendelsohn, of the Speedgun Corporation, in developing new techniques in synchronization design Many of the models turned out by this division are never seen by the general public, but the facts learned are incorporated in the design finally chosen for inclusion in the finished commercial product The research is pursued not only for the sake of perfecting designs for current requirements, but also to keep a weather eye out for future needs and developments

One of the items that will see the light of day in the near future is the Multiflector, a reflector-magazine holding six No 5 G E "Mighty Midget" bulbs, these are mounted on the gun in the usual way and the lamps flashed either individually or in unison, depending on the number of switches thrown A special carrying case holding six of these Multiflectors will be available, thus making it possible for the photographer to load 36 bulbs at once and never handle a single bulb until they have all been flashed "On the fire" is another gun to be known as the Superspeed, which will fire 12 flashbulbs one after the other and which can be operated either on or off the camera

For accurate testing of shutter synchronization, a Speedgun Timer has been made available to newspaper offices and will soon be ready in sufficient quantity to be placed in centrally located agencies throughout the country The tester works at 1/10,000 of a second and permits ready testing with every assurance of certainty as to the result

Portraits With A Spectacle Lens

Get your optician friend to make you up a spectacle lens of a focal length your camera will accommodate, mount it in a square of cardboard of the right dimensions to fit the front of your camera, and try your hand at soft-focus portraits The results may surprise you The illustration is an example Notice how the highlights spread out into the shadows and a general softness of outline prevails over the entire face Sharp pictures are not always the best pictures, particularly in the case of portraits, a soft picture such as this may often be superior

With a spectacle lens

Fine-Grain Developer Formula

A fine-grain formula that appeared in the older issues of the "Gevaert Formula Book" is reprinted in the current issue of the *Gevaert Sensitizer* It consists of only metol and sodium sulfite made up as follows

Metol	1/4 ounce
Sodium sulfite—	
(anhydrous)	3 1/2 ounces
Water to make	32 ounces

Development is for 20 minutes at 65 degrees Distilled water is recommended The developer is said to keep a very long time

National Photonews Weekly

A weekly journal of news and comment concerning matters photographic and cinematographic has recently made its appearance, with headquarters in Washington, D C An-

—CAMERA ANGLES—

nounced as "a national publication for amateur photographers," it is published every Saturday under the editorship of Don Bennett. The publication states that it "welcomes news of the activities of camera clubs and individuals and manufacturers interested in amateur photography," and asks that in submitting copy having a time element, the contributor should allow for the lapse of one week's time The publication should be addressed National Photonews Weekly, Editorial Office, News Building, 1013 Thirteenth Street, N W, Washington, D. C

Labels on Bottles

ONE of the most vexing darkroom problems is how to make labels stick on bottles If some way were found to prevent sloshing water or other liquids over the label, there would be little trouble, but as this usually appears to be unavoidable, it it necessary to provide a means of protecting the label under all circumstances A suggestion is offered by Morris Germain, A.R.P.S., that he claims has worked for him for a long time He takes a few sheets of undeveloped glossy printing paper and, by the ordinary darkroom printing safelight, immerses it in the regular fixing bath. After the paper has been "fixed out," he turns on the white light, washes the paper in the usual way and then allows it to dry on a ferrotype tin He then cuts the paper up into the sizes he needs and letters the paper with black waterproof ink When the ink has dried thoroughly, he wets the paper again, squeegees out the excess water, applies ordinary library paste on the back and attaches it to the bottle The last operation is a coating of spar varnish

New Reflex Case

A SOLE leather, velvet-lined carrying case for the new Brownie Reflex Camera is being offered by United Camera Exchange of New York City

The case follows the styling and design of similar cases made for more expensive cameras of the candid type, and features a drop front allowing full freedom for the finder and taking lens, it also has a die-cut window in the rear so that film exposure numbers can be seen as the film is wound The cord furnished by Kodak as a part of the Brownie Reflex is used as the carrying strap

For Nature Shooters

SHOOTING insects and other small creatures frequently offers obstacles because they cannot be kept in one place long enough for the necessary critical focusing (close-up lenses being required) and relatively long exposures One worker got out of the difficulty by placing the insects in a bottle and then injecting into the bottle a small quantity of illuminating gas from the kitchen gas jet. The creatures become dulled and as a re-

BOOKS for BOOKS

Amateur Photographers

New Ways in Photography, *by Jacob Deschin* Eminently practical from every point of view, this new book contains nothing of theory and nothing that the advanced amateur photographer will not find valuable in one way or another. It covers the whole range of amateur photography, discussing such things as trick photography, photomurals, retouching, infra-red, and a number of other subdivisions that will not be found elsewhere in as clear and concise a manner. $2.85.

So You Want to Take Better Pictures, by A. P. Peck *A friendly, face-to-face chat with the camera owner who has his developing and printing done at the photo shops, yet wants to know enough about his camera and its uses to enable him intelligently to utilize it to best advantage Over 200 pages, dozens of illustrations. $2.10*

Universal Photo Almanac and Market Guide. How, when and what to photograph in order to make money with your camera, where to sell different types of prints. $1 00.

Amateur Film Making, by George H Sewell, A R.P S *Useful to the beginner as well as the expert movie maker. Tells about films, cameras, exposure, film editing, story telling with the camera, and so on. Illustrated. $1.60.*

Champlin on Fine Grain, *by Harry Champlin.* A complete hand-book on the entire subject of fine grain, including formulas and how to compound and use them. $2.10.

Photographic Hints and Gadgets, by Fraprie and Jordan. *How to make all kinds of photographic accessories, from film clips to cameras to lighting equipment, and so on, 250 articles and nearly 500 illustrations. $3.60.*

Portrait Photography, *by H. Williams.* Fundamental principles of composition and lighting, paving the way to satisfactory results in this particular branch of photography. $4.35.

Photographic Enlarging, by Franklin I. Jordan, F. R P. S. *One of the most interesting and authentic books on enlarging. Its 224 pages cover every phase of the subject and 75 illustrations, many of them salon-winners, show the value of correct technique. $3.60.*

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24 West 40th Street New York City

BOOKS BOOKS

sult move very slowly It is a simple matter then for the photographer-naturalist to place the insect where he pleases and to take his time about focusing and shooting For the information of the tender-hearted, the effect is temporary and after the gas wears off the insect moves normally again.

• • •

WHAT'S NEW

In Photographic Equipment

Moore "Long Fellow" Enlarger ($50 without lens) Features coolness, compactness, versatility Both enlarger and baseboard mounted on 90-inch chromium plated tubular upright. When not in use, enlarger and baseboard may be swiveled against wall Suction ventilation of lamphouse, aided by insulation of lower condenser from body of lamphouse, results in negative being absolutely cool There is no material rise in temperature, even if negative is left in enlarger for period of several hours without any air circulation other than that provided by enlarger itself Enlarger employs metal sleeve bellows Equipped with three lens boards, recessed, flat, and protruding to take all normal focal length lenses up to and including 6-inch Employs double condenser system, 4½-inch condensers removable for cleaning Position of light bulb adjustable Equipped with plastic light filter for use when focusing on paper Focusing by micrometer gear Will take negatives 35mm to 2¼ by 3¼ inches and any 2¼ by 3¼-inch portions of negatives up to 11 by 14 inches Wooden baseboard, crack - proof, warp - proof measuring 20 by 30 inches, may be rotated through 360 degrees, vertically or horizontally, allowing for any desired distortion or correction Two brackets furnished with 90-inch upright for attaching to side wall or floor and ceiling Regular table model also available called "Short Fellow" ($40 without lens)

Brownie Reflex ($5 25) Miniature twin-lens reflex camera for beginner Large, brilliant, efficiently hooded reflex view finder, image remains visible during exposure Takes 12 pictures 1⅝ inches square on No. 127 roll Size of camera 4¾ inches high, 3 1/3 inches wide, 2¼ inches through Compact design without projecting fittings Automatic self-cocking shutter with bulb and instantaneous settings, and plunger-type release Lens good quality meniscus of correct speed for daylight snapshots, as well as snapshots at night with high-speed film and Photoflood set-up. Fixed focus.

General Electric Type DW-48 Exposure Meter ($21). One-hand operation made possible by special calculator arrangement, spring-actuated hinged cover, new locking device. Meter calibrated to measure

light in standard foot-candles By means of incident light and hinged cover, single scale on meter covers range of sensitivity from 0 05 to 1700 candles per square foot New feature permits locking calculator after reading is taken so that calculator adjustments will not change if meter is put in case or pocket Other features simplified calculator for still, color, and movies, self-multiplier on calculator which automatically multiplies exposure when meter is used for incident light measurement, film values up to 800, F stops from $f/1$ to $f/44$ and shutter speeds from 1/2500 of a second to 100 seconds Accompanying each meter is 110-page data book giving film values, filter factors, Photoflood and Photoflash data, paper speeds, and formulas

RECOR FRESHMAN PHOTOGRAPHIC KIT ($11 95) Outfit includes camera, enlarger, rolls of film, roll-film developing tank and all necessary darkroom accessories chemicals, enlarging paper, film safelight, thermometer, film clips, trays, and so on Manufacturer says "While primarily designed for the youngster and beginner in photography, it will also appeal to the more serious minded worker as providing a practical groundwork in the fascinating hobby of photography"

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THE ROUND TABLE

Questions Answered for the Amateur Photographer

Q I am planning to make an enlarger My largest size negative will be $2\frac{1}{4}$ by $3\frac{1}{4}$ inches. In consulting a table I find a $4\frac{1}{2}$-inch focal length lens requires a distance of $6\frac{3}{4}$ inches from negative to lens for a two-times enlargement. Could I use a single extension camera ($4\frac{1}{4}$-inch focal length) for the lens and bellows by fitting a light-tight box on the back of the camera?—C. R. W.

A The arrangement you suggest sounds practical enough because you will have sufficient leeway in your bellows for the necessary adjustment for a wide range of magnifications It is important, of course, that the box you construct fits snugly over the back of the camera and permits no light to escape around the connecting edges

Q Where or from whom could I get specifications on the many lenses that are on the market for the miniature enthusiast to choose from? Details I want to get include the type class of the lens, good characteristics and limitations, diameter of circle of confusion, degree of color correction, method of focusing, size of plate covered at full and at reduced aperture, and so on. Such a jumble of names (Ektar, Cintar, Triotar, Tricor, Elmar, Hektor, Zenor, Hypar, Dagor, etc., etc.) means so little to me.—W. L.

A. Some of your questions are answered in scattered sources, but we

do not know of any one complete reference where information such as you want may be obtained However, the individual manufacturers or distributors are always glad to supply such information on request Their addresses can be obtained from magazine advertisements or from your regular photographic dealer

Q **Enclosed are a couple of vest-pocket size negatives and a couple of commercial prints I know the composition isn't so hot and the lighting is terrible, so don't bother to card me out about that. However, a strong magnifier on the negatives shows a lot of detail that does not show up in the prints. Now the question. Could an old bird like me (fiddling with cameras for forty-odd years) do any better if he got a hundred dollars' worth of equipment and spent his spare time in the cellar? Is there any likelihood of better results if I were to do the work myself instead of sending them to a finishing plant?—H. A H.**

A That depends on the plant to which you send your films Some of them are first rate In general, however, you could probably do much better in many instances because you would be able to give the work more time The negatives you enclose seem rather contrasty and should have been developed in a soft-working developer because of the contrasty lighting employed You would know this and would be willing to use the proper developer for the type of exposures made This is one great advantage of doing the work yourself As for the prints, a softer paper might have helped matters some In general, it is far better that the serious worker do the processing himself The results will be more satisfying because the worker will be able to give each print the care and attention that the average finishing plant does not have the time for, the prices they get would not justify the effort

Q **I have a Contax III with a f/1 5 lens. Can I use it in an enlarger of the Kodak type?—Dr. H. D.**

A We do not know which of the Kodak miniature enlargers you have reference to, but, provided it will accommodate a 2-inch lens, you should be able to adapt it to the enlarger Of course, a special lens flange will be required

Q **I have a 2¼ x 3¼ Speed Graphic and I use an Abbey battery case and reflector for the built-in focal plane synchronizer, with Press 40,000 flash bulbs. I shoot at 1/225 at f/8 and the exposures are perfect, but when I drop the exposure down to around 1/100 the density begins to fall off at the bottom of the negative.—M. K.**

A The Press 40,000 bulbs should not be used with shutter speeds slower than 1/200th second, according to the advice of the manufacturers This speed—or greater—permits the focal plane shutter to traverse the film while the light is at its peak.

YOUR FIREARMS AND FISHING TACKLE

Conducted by A. D. RATHBONE, IV

INTEREST IN FIREARMS *is traditional with American men, fishing tackle is a requisite of one of the world's oldest occupations Scientific development of guns and tackle, in the use of which millions yearly find sport and recreation, fathers this monthly department which welcomes correspondence from readers*

It's Called "Targo"

SOME will nick-name it "back-yard skeet," some may call it "vest-pocket trap," but the Mossbergs have termed their latest innovation "Targo," and all who try it will sing its praises from the standpoint of good gun fun and excellent wing shooting practice The best part of the story is that, following their principle of providing shooting enjoyment for more people through good equipment at moderate

Cocking

prices, O F Mossberg & Sons, Inc, have arranged to offer their new combination gun-and-trap, together with miniature pigeons to be used with 22 caliber long-rifle scatter shot shells for indulging in the sport of "Targo" at so nominal a figure as to make the game available to all For less than $25 you can own the gun, the trap, and even a net to save undusted pigeons from breakage when they hit the ground Your operating costs will be equally low, for the 22-caliber shot shells can be had for 50 to 60 cents per box of 50 and the clay birds will be much less than one cent apiece

The Mossberg Model 42 TR "Targo" gun is in reality two guns in one, for each comes with what is known as a "Rifle Adapter Tube" This is a rifled section of 22 caliber barrel, 5 inches long, which replaces a length of "Targo" gun smooth-bore barrel, and which, by an ingenious new method of rifling, converts the "Targo" gun into a 22 rifle which is claimed to be as accurate as though rifled throughout Furthermore, there is a 7-shell capacity clip in the forearm below the chamber which makes a bolt action repeater out of the gun, shooting any standard .22-caliber solid ammunition

"The Targo" gun is built on the Mossberg "Master" action, walnut finish stock with molded trigger guard

Loading

with finger grooves and molded butt-plate It is 43½ inches long, weighs about 5¼ pounds and balances nicely with or without the trap It has a 22-inch round, smooth-bore barrel, and when fitted with the 8-inch "Targo" tube equipped with a special choke ring to prevent the shot from balling and coming out as slugs, it gives a nice, even pattern

The "Targo Trap" weighs 14 ounces, is attached to the barrel just ahead of the forearm, is easily removed and will fit almost any single barrel 22-caliber smooth bore or 410 bore shotgun The trap cocks effortlessly, is released by the fore finger of the left hand while the gun is at either skeet or shoulder position The swing of the trap as it throws the "bird" is not sufficient to produce an appreciable sideways recoil in the gun To the contrary, the backward thrust is scarcely noticeable as the target sails through the air in any direction desired by the shooter, and it will be at once understandable that the variety of angle shots possible are almost legion An adjustment on the spring permits you to vary the flight of the targets, making the shooting easy or difficult, as you like

The "Targo" targets are ½ normal size, will break on impact of the tiny 22-caliber pellets up to 50 feet, and are packed in lots of 200 in special break-proof cartons developed by Mossberg When the Mossbergs say "break-proof," they mean it During a recent visit to the factory, Walter Pierson told us of some of the tests to which target-loaded cartons had been subjected They threw the packed cartons down the factory stairs, pushed them out the window, dumped them off fast moving trucks and generally kicked the poor things all over the lot. Even when they finally found a packing method which enabled the targets to survive such blitzkriegish treatment, they weren't

Releasing

satisfied When you receive your first carton of "Targo" targets, you'll find a few extra for good measure and as a sort of "just-in-case" precaution Furthermore, five unbreakable targets, made of rubber, are a part of each "Targo" trap outfit These are used in distance and direction experiments with the trap, thereby saving a lot of clay pigeons

The "Targo" net, insurance against ground-smashed pigeons, is 20 feet square, is easily set up on 6-foot posts and has a mesh fine enough to catch

"Targo" birds and shells

and save undusted birds, but large enough and sufficiently flexible to permit the netted targets to be drawn through the net from below. With or without the net, "Targo" is a new sport to be enjoyed just about any place, including an open field, the golf or gun club, or even a large back yard The 120 to 130 pellets of a scatter shot .22-caliber shell are very tiny and are unlikely to cause damage when properly used, but as it still takes only one pellet to ruin an eye, don't forget the tried and true Commandment of Safety, "Never point a gun at anything you do not want to shoot." All-in-all, we believe "Targo" has unlimited possibilities for fun and helpful firearms practice Want a "Targo" booklet?

Clean Barrels Shoot Better

It's a strange indictment against the gunning fraternity that about 98 percent of the enormous annual repair bill for guns is traceable to the owner's neglect. The introduction of non-corrosive ammunition led not a few to the belief that, save for an occasional patch and oil, the barrel cleaning chore was a thing of the past True, non-corrosive shells will not rust the tubes, but they are primarily intended to knock over game or skeet targets, not to *prevent* rust. Likewise, the little problem of leading is still with us, and for some reason scattergun owners seem more prone than riflemen to rely only on oils, greases, and rags to remove lead, perhaps on the theory that the new powders fired through a clean bore with no rifling eliminate the necessity of this operation

In view of the extensive array of shotgun cleaning agents available, all at a very nominal cost, there is really no reason why shotgun barrels should not receive the best of care with the result that patterns will be improved, kills will be cleaner, and the gun will last longer As every gunner knows, lead in barrels retards and mutilates the pellets, causing them to sheer away from their normal flight and ruin an otherwise effective pattern

Not long ago we mentioned a new shotgun cleaning device known as the "Ferret Cleaner," and we have since observed that it has met with wide-spread approval from scattergun men Like other tube-scouring implements, the Ferret is designed to remove lead deposits, and not to be used to the exclusion of a good oil, or grease, and a rag But, unlike the old style wire bristles, the Ferret "shaves" the lead from the barrels instead of brushing it off, often a not too effective process

Composed of flat, bronze alloy wire, soft enough to prevent gun barrel injury yet hard enough to get at the lead, the Ferret is tapered at both ends to permit passing through the choke in both directions, either on the cleaning rod or on a stout cord It is self-sharpening and works even better after having been used a few times As the coiled, flat wires are formed into a tapered, cylindrical shape, it is unnecessary to impart a revolving or rotating motion to the rod when running it through the barrel

A recent letter from T R. Walker, of The Dairy Specialties, Inc, manufacturers of the Ferret, stated "Since we have been making Ferret cleaners we have been surprised to find that many men who have used guns for years do not realize that they have lead in their gun barrels. When they clean their guns with a wire brush and patches, they polish up the lead until the gun looks clean Then, when a Ferret is run through, and they see the amount of lead which is removed by the bronze wires, they are unable to believe their eyes" All we can add is that we continue to use a good grade of oil for cleaning and lubricating, that we "Ferret our guns" religiously after shooting and that we believe the combination provides good insurance for longer lasting firearms and few, if any, repair bills resulting from neglect of our guns

Aluminum Creels

We've often wondered why someone didn't make a creel of aluminum, and now along comes Messrs. Smith & Focht with their "Ideal Creel," which appears to us to be very well named, indeed. Weighing but a few ounces more than our old reed

basket, the "Ideal" is 12 inches long, 8¼ inches high in back, 6-1/4 inches high in front, and 6 inches wide. It is extremely durable and the sprayed, brushed aluminum finish not only gives the creel an attractive appearance, but also prevents sun flash

Best of all, to our notion, is the conversion of hitherto waste and useless space into additional convenient storage places for important items for the stream angler Besides the well-ventilated fish compartment accommodating eight pounds of fish and equipped with drainage openings which will not drain on the user's clothing, there is a tackle compartment This has spaces for fly books, leader box, fly oil, line dressing, skeeter dope and a built-in, removable bait box There is also a drawer for sinkers, hooks, leaders, minnow rig, and other small items Inasmuch as we're one of those fishermen who isn't happy unless he can lug along everything but the kitchen sink, and as we've wished often for a place to carry our camera, we think we're going to like the Smith & Focht "Ideal Creel" Would you like a descriptive folder?

"Ideal" for stream anglers

POT-SHOTS
At Things New

Stoeger Arms Corporation has just brought out its latest publication, an attractive 24-page book entitled, "Stoeger Gun Stock Guide" It offers complete information concerning remodelings, gunsmith specialty tools, Peerless actions and barrels, Peerless remodeling of military and sporting rifles, American and French walnut stock blanks, blueing equipment, standard targets, and many other items of interest to the amateur gunsmith This new book is not to be confused with the annual "Shooters Bible," published yearly by The House of Stoeger, for the new one stresses tools and materials for remodeling and other gunsmithing activities. For more than 50 years A F Stoeger, Founder and President of Stoeger Arms Corporation, has been widely known for his helpful service in connection with American and imported guns and accessories Long an expert gunsmith himself, he subscribes to the school of thought that every gun owner should intimately know each part of his gun and how to care for it

Federal Cartridge Corporation offers new wadless crimp shotgun shells in trap and skeet loads only, in 12, 16, and 20 gage An increased number of folds in the crimp tends to reduce initial pressure and prevent deformation of pellets All well-known good points of Federal loads have been retained in new shells, including hot, snappy primer, locked-in base, cone-shaped base wad, reasonably soft, tough paper case, "old reliable" hair-felt cushion wads, clean, bright, uniform shot Federal also offers new rifled slug loads for shotgun use in 12, 16, and 20 gage, and 410 bore Likewise new are 28-gage loads in 2⅞-inch hi-brass cases, with numbers 4, 6, 7½ chilled shot, and in skeet loads with number 9 chilled shot

Remington Arms Company offers new, soft point "CoreLokt" bullet equipped with notched jacket tip, which controls mushrooming, provides uniform expansion and makes it readily recognizable Heavier base of jacket prevents disintegration, locks lead core, retains compact mass of non-disintegrating bullet to full depth of penetration and energy The "Core-Lokt" soft point starts mushrooming

"Core-Lokt," showing notches and expansion: also vise test

immediately, expands to approximately twice original caliber at hunting ranges, retains same ballistics as regular soft point bullets in comparable weights Simple pressure test in ordinary vise shows how special notching of jacket provides directional spreading lines for perfect expansion The "Core-Lokt" soft point costs no more than ordinary soft points, is available in 14 sizes. 25 Remington, 25/35, 30/30 (2 bullet wgts.); 30 Remington, 30/40 (2 bullet wgts), .30/06 (2 bullet wgts); .300 Savage, .303 Savage, 32 Special; 32 Remington, 35 Remington

Flash" — Colt's Patent Firearms Manufacturing Company have just sent word that the long-awaited "History of Colt Revolvers" by Charles T. Haven and Frank A. Belden is on the press and will be ready September 1st This 700-page volume with 500 illustrations, handsomely bound with embossed cover, will prove a reservoir of information of daily value to every collector and lover of firearms.

Our Book Corner

THE BOOK DEPARTMENT of Scientific American is conducted, with the co-operation of the Editors, to make available for you a comprehensive book service. Each month the Editors select and review in these columns new books in a wide range of scientific and technical fields. In addition, they are ready at all times to advise you regarding the best available books on any subject. You are invited to use this service freely Tell our Book Department what kind of books you want and you will be furnished with a list of available titles, including prices. When inquiring about books, please be specific; remember that we can be of the greatest help only when you tell us just what you are looking for.

EXTRA - SENSORY PERCEPTION AFTER SIXTY YEARS

By J B Rhine, J G Pratt, Burke M Smith, Charles E Stewart, and Joseph A Greenwood

At last there is a complete account of the research conducted to date on extra-sensory perception (thought reading, telepathy, clairvoyance), all the important scattered data having been brought together here within two covers This book is a summary of what has been achieved so far, a reference work covering the field as a whole, a treatment of all the evidence, a guide to the literature of the subject, a condensation of the greater bulk of it, and a handbook of methods It includes a digest of 56 articles of criticism of experiments in extra-sensory perception, mainly as made by psychologists, in which these are dealt with without emotion or heat, in fact, the whole work is characterized by a commendable kind of calm, in view of the degree of superheat that has been connected with the subject This book is a solid, serious study, there is nothing fluffy about it, but it is not heavy The parts involving mathematical analysis are sequestered in 21 appendices, for readers who yearn to delve (463 pages, 5½ by 8½ inches, eight illustrations)—$2 85 postpaid —*A G I*

SCIENCE FRONT 1939

By F Sherwood Taylor, Ph D

Chapters on science and plant growth, chemotherapy, sex and the steroids, the stuff of life, cancer, shock treatment for schizophrenia, making oil from coal, television, liquid helium, inside the atom, quartz clock, polar aurora, our view of the universe, together make up this most readable review of recent science—much of it, not quite so recent, however, as 1939. (301 pages, 4¾ by 7¼ inches, 52 illustrations) —$2 60 postpaid —*A G I*

THE FLY TYER'S HANDBOOK

By H G Tapply

Whether or not you tie your own flies, this publication should be in your library. Through word and picture it tells you more about flies and fly-tying in one evening than you could assimilate in years of desultory study on the stream Written for the beginner in a successful endeavor to reduce fly-tying to its simplest form The author, who is Editor of *National Sportsman*, and a fisherman par excellence, clearly disproves the common fallacy that tying one's own lures is a difficult art (71 pages, 5½ by 7 inches, 56 illustrations)—$1 10 postpaid —*A D R, IV*

PRINTING INKS

By Carleton Ellis

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TELESCOPTICS

A Monthly Department for the Amateur Telescope Maker

Conducted by ALBERT G. INGALLS

MONKS, like thousands of other mortals, are now making their own telescopes From the Society of the Divine Word, Techny, Illinois, comes the following

"Even in the crowded curriculum of studies at St Mary's Major Seminary, astronomy has its place and holds an attraction for many a student Its

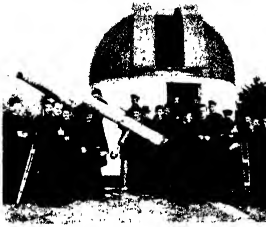

Figure 1 Astronomy class, St. Mary's

study serves a definitely practical purpose, since most of the seminarians will one day labor in foreign mission fields, where astronomical knowledge will supply in many ways what these primitive countries do not—aids in regard to time, in regard to nautical determinations, in surveying, and in exploration, to mention but a few

"A few years ago an observatory (Figure 1) was built at Techny, housing a 110 mm refractor, a comet-seeker, the structure having been designed and constructed by the Brother Monks But this telescope soon proved inadequate for the interest and enthusiasm of the star-gazers, and it was deemed advisable to construct a larger one, 8" in aperture, the work being done under the direction of Father Francis Neuhaus, S V D, one of the seminarians Meanwhile, Brother Corsinus, S V D, an able mechanic, was busy constructing a well-balanced mounting, shown in the center With a surprising minimum of cost, the reflector was completed, and now serves to great advantage, not only to bring more of the heavens within grasp, so to say, of the students of astronomy, but also to render celestial photography possible because of the new telescope's greater light-gathering power

"Work on a 12½" mirror for a still larger telescope is now under way"

AMATEUR telescopticians, ten or twenty thousands of them, have now felt their way into about all the related arteries and capillaries of optics and astronomy One such ramification is sun-dialling, and under sun-dialling come sun-clocks Just what is a sun-clock?

Invented by W E Cooke, government astronomer of New South Wales, Australia, the sun-clock was described in this magazine in August, 1928, also August, 1935, by R W Porter A ring, or sometimes a C-shaped portion of a ring (Figure 2), carries a lens on the sunward side, and on the other an analemma, the familiar 8-shaped curve of the equation of time By turning a thumbnut with the fingers, until the Sun's image falls exactly on the analemma, hands taken from an ordinary clock are mechanically actuated through gear trains and the standard time is read on the clock dial—direct and not by a shadow, as in a sun-dial There is, of course, no running clock *movement*

Working from the articles by Porter, cited above, Fred Ferson, 414 Reynoir Street, Biloxi, Mississippi, has made the sun-clock shown in Figure 3, and states that "careful construction and adjustment afford time within one minute, likewise the date The base casting has four leveling screws and carries a second casting which supports in a curved slot a short, stubby, curved main standing arm This can be slid circularly and clamped for latitude At the end of this stubby arm is a rigid, hollow stud carrying the gear

Figure 2: Porter, sun-clock

Figure 3. Ferson's sun-clock

box and clock face and big, curved, rotatable fork The fork has in its upper horn a slot in which is mounted a little lens of 8" *f l* The analemma is inscribed on a sheet brass plate bent to a radius equal to the *f l* of the lens (its radius of curvature is therefore nearly twice that of the fork—study Figure 7 if "nearly" is not at first clear) and attached to the lower horn To find the time at any desired moment the large thumbnut extending, in Figure 3, below and to the left of the gear box is turned with the fingers, and gears with ratio 1, 2, and 24 do the rest, that is, 24 revolutions of the handwheel will rotate the minute hand 24 times, the hour hand twice, and the fork once When the Sun's image is made to bisect the analemma curve the clock hands will automatically point to the hour and minute, also giving the date" Ferson will lend further details of construction to those seriously interested

Even now, more than a decade after he made his first sun-clock (Figure 2), Porter still composes new variations on the original theme and then makes the clocks Figure 4 is one of these, as set up in his door-yard at Pasadena "It consists," he writes, "first, of a spherical Pyrex flask carrying all the optical parts and the clock face, on which is also engraved the analemma The entire unit is encircled by a grooved equatorial ring sliding on a segment below, which is fastened to the base The equatorial gear used was a 32-pitch rack bent to fit the groove of the equatorial ring

"In adjusting the polar axis parallel to that of the Earth, a tubeless telescope, consisting of an eyepiece and objective, is fastened to the sphere at the poles of the encircling equatorial ring The field of view of the eyepiece contains just the apparent orbit of Polaris about the true pole, so that, by estimating the hour angle of Polaris by the stars in the Big Dipper and Cassiopeia, and using the base

screws, the polar axis of the instrument can be directly fixed.

"I find that the time can be relied on well within one minute. The glass flask was resorted to in order to protect all essential parts from the birds, who seemed to feel that I had made a gadget for their special benefit The neck of the flask and a part of the sphere were removed with a 'biscuit cutter' (simply a cylinder of sheet metal) and abrasive The plate of the clock, having nearly twice the radius of the sphere, was spun to its required curvature All the machining was done on a wood-working lathe and drill press in the pattern shop here at The California Institute of Technology Figure 5 is a photograph of another spherical globe sun-clock made earlier and partly similar"

And still another! Some months after the above descriptions were received, there arrived from Porter a note (Figure 6) and the following description "The clock to be described is about my tenth design and its performance has been so satisfactory that

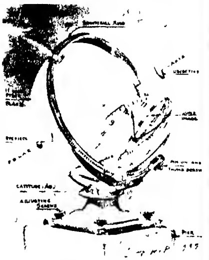

Figure 4: The bird fooler clock

I have decided to call it quits and turn the information over to those who may wish to have a gadget in their gardens demonstrating an interesting problem in celestial mechanics

"The drawing (Figure 7) is a meridian section through the instrument and for economy of space I have inserted, or superposed, the clock face in the central area, but its true position is shown in Figure 8

"*A* is a 12-liter Pyrex flask (Corning Glass Works—it cost $3 50), whose neck *B* has been removed with a biscuit cutter The flask is remarkably spherical.

"To this sphere are attached the lens *C* and the brass strip *D* on which is pasted the analemma

"In the space removed by the biscuit cutter is the clock dial *E*, carrying a minute hand Behind the clock face is a reduction gear box operated by the thumbnut *F* Only two pairs of stock, 32-pitch spur gears (Boston Gear Works, Cat. No. 1-G 159, 161, 177, 179) are necessary to make the minute hand revolve 24 times during

one revolution of the sphere. This clock and the gear case are fixed rigidly to the base ring *H*, supported on three adjusting screws *I*, *I*, *I*, 120° apart, and these screws rest in a circular groove cut into the plate *J* which, in turn, is securely fastened to the pier.

"The polar axis *L* of the instrument is created and maintained by the glass sphere resting in ring *H* and revolving around the stud *M* by means of a pin *N* engaging a slot in the sphere To save an extra pair of gears for the hour hand, this pin *N* serves equally well to indicate the hour The stud *M* has an inclination to ring *H* (horizon) equal to the latitude of the location, shown here as 40°.

"In operation, by turning the thumbnut, the sphere is rotated until the Sun's image falls on (and bisects) the analemma, and standard watch time is taken directly from the clock face A small portion of the analemma is shown at *O*, with the Sun's image as it would fall on the 15th of May, the portion opposite covering July and

Figure 5: Another similar type

August Should the image be made to fall on the center line at *P*, the clock would read apparent or sun time But *PO* happens to be the equation of time, so that, by using the analemma, standard time is obtained automatically Furthermore, any deviation of the observer's position east or west of the central line of the time zone in which he resides is corrected by resetting the minute hand This is, of course, a constant.

"The analemma is marked off in five-day intervals, so that the day of the year is given, as well as the hour and minute It is easily drawn from data in the nautical almanac

"I have found that the best illumination of the Sun's image is produced by an *f*/80-or-90 lens. In the clock here described the focal length is 10" and the lens ⅛" in diameter.

"Adjusting is done with a small temporary telescope, as previously mentioned By using the three adjusting screws *I*, Polaris may be brought to the required hour angle (see *Q* in upper, left hand corner) The telescope is removed (next day) and replaced by the sphere and clock unit.

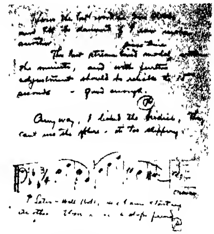

Figure 6· An addict's confession

"Finally, so that the instrument may be removed and taken indoors at any time and replaced without disturbing its alinement, a positioning stop *R* is provided, which is simply a strip screwed to *J* and against which the south adjusting screw rests"

The above description of a sun-clock, by Porter, is more detailed than those in the earlier, 1928 and 1935, articles referred to farther back, hence the would-be maker will not gain by hunting them up An enlarged photostat of Figure 7 is available, for a small sum, from the editor

Builders of such things as sun-clocks will occasionally hear this objection "What real, practical good or use is the thing, when we all own watches?" To a man having that type of mind a sun-clock is no good at all, and one suggested answer is simply, "None" This should stall him, completely To other types, however, such a thing is not only a pretty thing to own, but it visibly and tangibly demonstrates our precise knowledge of the Earth's motions in space, and thus the value is mainly intellectual

If this nation is dragged into a war, facts stated by Carl L Bausch, of the Bausch and Lomb Optical Co., Rochester, N Y, in an article on "Optics and Defense," in the May-June, 1940, number of *Army Ordnance* (Mills Bldg, Washington, D C), may interest readers of this department

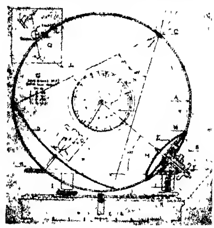

Figure 7: Porter's final (?) job

TELESCOPTICS

Mr Bausch states that "Bausch & Lomb is now making 24 types of optical glass The present monthly capacity is about 10,000 pounds per month . Practically all materials now used in glass making come from domestic sources, with the exception of nitrates which come from Chile in their crude form and are purified here . The choke point in glass making is no longer the procurement of sufficient and suitable melting pots The bottleneck has been transferred from the manufacture of glass to the manufacture of optical parts and to the assembly and adjustment of the instruments We could increase the output of our instrument plant five times in dollars-and-cents value of product in the first three years of an emergency It would be necessary to work three 8-hour shifts or, preferably, two 10- or 12-hour shifts We would have to add 4000 more employees to our payroll During the recent years of depression, mechanics have not been trained as they were previously, and I think it is safe to say that the available supply of trained mechanics today is less than

Figure 8: The same as Figure 7

it was in 1917 Without skilled labor available, it will be necessary to recruit younger employees into our organizations to increase production, as young workers learn a new job much faster than mature ones These (the 4000 new employees) will be divided as follows Glass plant 200, optical parts work 1000, manufacture of mechanical parts 1000, assembling and adjusting 1500, toolmakers, etc , 300."

Asked whether amateur opticians, such as read the present pages, could be used, Mr Bausch replied "We already have a couple men in our precision optics division who came through the amateur telescope makers' channel. We believe, everything else being equal, that a man who has had experience in making reflectors for his own use will be more valuable to us as an optician than one who has not had a try at it."

On to Rochester, you am-optical patriots—in case Uncle Sam fights!

STELLAFANE convention, Saturday, August 10 Porter coming.

LEGAL HIGH-LIGHTS

Patent, Trade Mark, and Related Legal Proceedings That May Have a Direct Effect on Your Business

By ORSON D. MUNN, Litt.B., L.L.B., Sc.D.
New York Bar
Editor, Scientific American

A Reminder

IMPORTANT changes in the Patent Law become effective on August 5, 1940 After that date an application for a patent cannot be filed more than one year after the invention has been made public either by being described in a printed publication or by being publicly used or sold Prior to this change applications for patents could be filed within two years after an invention has been made public Another change in the law, forming a corollary to the above change, provides that claims cannot be copied from issued patents for interference purposes more than one year after the granting of the patent

Loop Hole

THE Federal Trade Commission is not empowered to restrain unfair methods of competition or unfair and deceptive practices in intra-state commerce even though the unfair practices adversely affect interstate commerce, according to a recent decision of a Federal Circuit Court of Appeals

The Commission had instituted proceedings against a candy manufacturer charging him with using or promoting a lottery in connection with the sale of its candy The manufacturer sold assortments of candy to dealers In each assortment there were candies having differently colored centers and the purchaser of these candies was entitled to receive, free of charge, a larger piece of candy

In a prior case the United States Supreme Court had sustained the contention of the Commission that the sale of candy assortments of this type constitute an unfair method of competition and upheld the power of the Commission to restrain such sales in interstate commerce In the present case the manufacturer confined his sales of the candy assortments to the state in which he was domiciled Under the circumstances the unfair method of competition did not take place in interstate commerce

The Commission proved that the candy assortments were sold in competition with the product of other manufacturers who were engaged in interstate commerce and it was contended that the unfair method of competition in question adversely affected interstate commerce The Commission argued that it was empowered to protect the interstate commerce of the competing manufacturers by restraining the unfair methods of competition of the manufacturer proceeded against, even though these methods were employed solely in intra-state commerce.

The Court fully considered the contention of the Commissioner and did not deny that the unfair methods of competition adversely affected interstate commerce It concluded, however, that the powers of the Commission were limited by the Federal Trade Commission Act to restraining unfair practices in interstate commerce In this connection the Court stated

"The only practices with which the Commission may concern itself are transactions in interstate commerce The Commission's authority is to be found in the act which created it, as amended The purpose of the act was to supplement the Sherman Anti-Trust Act, * * * and to prohibit practices which were unfair and destructive of competition in interstate commerce"

Doubtful

A PATENT interference is a proceeding in the Patent Office to determine which of several contending parties is the first inventor and as such is entitled to receive a patent for the invention The usual interference involves two or more applications for patents However, at times an interference involves a patent and one or more patent applications When the interference is between applications for patents the burden of proof of the junior party—that is, the last party to file an application—is the same as in an ordinary civil suit and it is only necessary for the junior party to prove priority of invention by a preponderance of evidence However, when the interference is between an issued patent and a patent application filed subsequent to the issuance of the patent, the burden of proof of the junior party is the same as in a criminal case—namely, the junior party must prove priority of invention beyond all reasonable doubt

The importance of this distinction is illustrated by a recent interference involving a patent and a patent application The proof of the junior party in the interference in question depended to a great extent upon oral testimony and upon certain drawings The drawings contained additions and changes and the witnesses were unable to state exactly when the additions and changes were made The Court stated that the witnesses were

unquestionably men of good character but pointed out that there were certain weaknesses in the evidence—namely, the original model or device embodying the invention could not be found and was not produced and the drawings relied on admittedly included changes and additions Under the circumstances, the Court concluded that there was at least a reasonable doubt that the junior party was the first inventor and on this basis awarded priority of invention to the owner of the patent In reaching its decision the Court made the interesting comment that if the junior party were only required to prove his case by a preponderance of evidence then they would be justified in deciding in favor of the junior party

Paper Rolls

A PATENT for an improved press roll in a paper-making machine was held to be valid and infringed in a recent suit in the federal courts The patent related to a press roll made of crushed or ground stone held in a binder of vulcanized rubber Prior to the patent, press rolls in paper-making machines were made of iron, wood, various alloys such as brass, and also granite The Court found that each of the materials previously employed in press rolls gave rise to difficulties Thus the granite was too heavy, the brass would score and damage the paper, and the wood would crack

The Court found that the patented roll solved the problems presented by the rolls previously used and concluded that the patent was valid In an attempt to invalidate the patent the infringer cited certain earlier patents relating to rolls used in fruit presses and clothes wringers The Court refused to consider these patents on the grounds that they related to a remote and non-analagous art

Unprotected Panties

IN a case of human interest—but one which will certainly not affect the destinies of the world—a Federal Court held that a copyright cannot be obtained for a pair of rubber panties Suit was brought for infringement of a copyright relating to a folded greeting card containing the representation of a traveling bag on the outside and a pair of rubber panties pasted on the inside. The defendant's card differed from the copyrighted card in details but was similar in essentials The Court found that there was nothing new in the representation of a bag on the outside of the card and that this feature was not protected by the copyright. The Court also held that there was nothing "of literary or artistic production in the pants, any more than in a cigar or a safety pin attached to a card" and concluded from this that the panties were not subject to copyright protection under our laws.

(The Editor will appreciate it if you will mention Scientific American when writing for any of the publications listed below.)

TRADE MARKS, LAW AND PRACTICE OF, is a copyrighted reprint, in 24-page booklet form, of an address before the New York County Lawyer's Association The discussion details the problems of trade mark selection, protection, and use—what can and what cannot be used, protected, and why. *Sylvester J Liddy, 24 West 40th Street, New York, N. Y —Gratis*

AGFA FORMULAS FOR PHOTOGRAPHIC USE (revised edition)is a 32-page booklet including more than 45 formulas which have general photographic application The booklet lists formulas for developing, fixing, short-stop, toning, reducing, intensifying, and desensitizing solutions A valuable section is devoted to a detailed but simple description of the chemistry of development, with new information on developer exhaustion and time-temperature compensation *Agfa Ansco, Binghamton, New York, or through photographic dealers.—10 cents*

ARTIFICIAL LIGHT AND ITS APPLICATION is a 296-page spiral bound book which gives up-to-date information on the latest lighting practice. It was written by experts, in clear and comprehensive manner, for lighting engineers, students, and laymen. Over 400 illustrations are used to show recent developments in fluorescent, electrical discharge, and incandescent light sources *Advertising and Sales Promotion Department, Westinghouse Lamp Division, Westinghouse Electric and Manufacturing Company, 150 Broadway, New York, New York —$1 25*

USE AND ABUSE OF WOOD IN HOUSE CONSTRUCTION, Miscellaneous Publication No 358, is a 24-page thoroughly illustrated booklet which will be of interest to present and prospective home owners. It presents practical facts regarding wood in building construction, accompanied by a large number of photographs. It covers the entire subject from cellar to shingles *Superintendent of Documents, Washington, D C.—10 cents (coin)*

VENETIAN BLIND MANUAL is a 24-page illustrated catalog that presents specifications, standards, and design data on venetian blinds and their installation It deals with both wood and metal blinds. *Chicago Venetian Blind Company, Michigan at 39th Street, Chicago, Illinois —Gratis.*

PHOTOELECTRIC ANALYTICAL METHODS is a 24-page bulletin which contains abstracts of a large number of recently published technical descriptions. The exact details are given for the applications of these methods with one particular type of Photometer. *Wilkins-Anderson Company, 111 North Canal Street, Chicago, Illinois.—Gratis.*

HOW TO CUT COSTS AND INCREASE PROFITS is a saw manual edited for those whose work involves production processes which necessitate the use of saws. It is specifically concerned with the "Speedmatic" saw for use in building, shipping, maintenance, manufacturing, and so on This saw is a high-speed, power-driven, but hand-guided, portable device *Porter-Cable Machine Company, Syracuse, New York.—Gratis*

PATTERSON PEBBLE AND BALL MILLS is a 32-page illustrated catalog of high-grade machines for use in the fine-grinding field A large number of types are illustrated and described and their uses are dealt with briefly but clearly *Patterson Foundry and Machine Company, East Liverpool Ohio —Gratis*

ROADSIDE DEVELOPMENT is a 64-page typewritten report of the Joint Committee of the Highway Research Board and American Association of State Highway Officials It deals largely with the work which is being done to beautify highways in the United States and to protect them both functionally and in relation to adjacent land use It takes up such matters as zoning of roadside businesses, the limited use of roadside signs, and so on *Highway Research Board, Division of Engineering and Industrial Research, National Research Council, Washington, D C.—50 cents*

UTILO FILTERS AND COMBINATION LENS SHADES is a 14-page booklet devoted to a description of American-made optical glass color filters, supplementary lenses and combination lens shades In addition, the booklet provides a comprehensive guide to the use of filters and supplementary close-up lenses under various conditions. Filter factors are given for Eastman, Agfa, and Gevaert films. Fully illustrated in color and black and white *Photo Utilities, Inc, 10 West 33rd St, New York, New York —10 cents*

RAILWAY LITERATURE FOR YOUNG PEOPLE is a bibliography of books and periodicals that is designed to answer many inquiries which are received by American railroads regarding various phases of operation *Association of American Railroads, Transportation Building, Washington, D. C. —Gratis*

THE GLUED LAMINATED WOODEN ARCH is a 124-page illustrated booklet that deals specifically with this particular type of construction, citing advantages and disadvantages and showing many of the functional applications Technical Bulletin No. 691, U. S. Department of Agriculture. *For sale by the Superintendent of Documents, Washington, D. C.—20 cents (coin).*

Printed in the U S A Press of the Wilson H Lee Company, Orange, Connecticut.

WHEN OIL-WELL drills strike really hard going in rock or tightly packed shale, rock bits, such as those shown on our front cover, get the assignment (see also page 134) These bits consist of rollers which rotate on bearings as the drill pipe spins, the teeth chipping away the rock as they revolve

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SCIENTIFIC AMERICAN

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NINETY-SIXTH YEAR • ORSON D. MUNN, Editor

SEPTEMBER • 1940

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50 Years Ago in . . .

SCIENTIFIC AMERICAN

(Condensed From Issues of September, 1890)

EIGHT-HOUR DAY—"The House of Representatives has recently passed a bill ordaining that eight hours shall be considered a day's work for all laborers, workmen, and mechanics, now or hereafter to be employed by the government"

MONEY—"Congress ought to issue a sufficient amount of fractional paper currency to facilitate exchange through the medium of the United States mail The people found it useful, and it never ought to have been abolished"

SINKING WOOD—"There are 413 species of trees to be found within the limits of the United States and Territories, 16 of which, when perfectly seasoned, will sink in water All the species heavier than water belong to tropical Florida or in the arid West or Southwest"

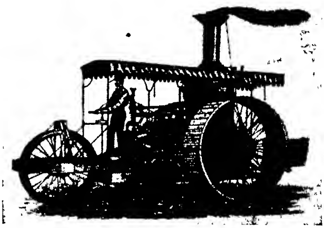
MACHINES AND LABOR—"The successful introduction of typesetting machines into a number of newspaper offices in the United States has greatly stimulated their competitors, and early in the autumn the New York *Sun*, *Times*, *World*, and other papers will commence their use It is also said that the *Herald* will employ them A member of New York Typographical Union No 6 says 'Of course, some members of the Union are a little skeptical as to the benefit these machines will be to the followers of the craft, but the whole history of labor-saving machinery teaches us that nothing has yet been invented that has lessened the need of good workmen'"

COMPOSITIONS—"A new mode of treating hemp, jute, and other fibers for making materials for the manufacture of tiles, slabs, cisterns, boats, and other articles or structures has been described in a recent patent specification"

WATER POWER—"Cataract Construction Company has secured a large area of land (several square miles) on the Niagara River, beginning a mile and a half above the falls, and all rights of way for carrying a tunnel under Niagara Village to a point below the falls The general plan is to construct a tunnel about 27 feet in diameter from a point below the falls to the upper limit of the secured property This tunnel will have lateral branches at a depth of about 100 feet from the surface, into which will be sunk numerous vertical shafts at the points where power will be required A system of surface canals will bring the water of the river to the heads of these shafts, and its action on turbines at the lower ends of the shafts will develop about 150,000 horse power The amount of water diverted for this purpose will be a small fraction of one per cent of that going over the falls"

BROKEN NECK—"Physicians connected with the Presbyterian Hospital are highly elated over the fact of their having successfully mended a broken neck The patient, aged fourteen years, fell from an elevator, landing on his head and dislocating his neck When brought to the hospital the case was considered hopeless, but by experiments with extending weights attached to the patient's head and feet the neck was eventually set and kept in place by means of a plaster of Paris jacket The displaced bones are now properly set and the patient has full power of the neck"

STEAM TRACTOR—"Among the latest machines designed for use on large farms is the new field locomotive of Jacob Price, of Racine, Wisconsin, illustrated herewith It is said that this machine pulled, near San Leandro, an outfit of twelve 11-inch plows in a dry, adobe soil, traveling at the rate of over four miles per hour in doing so, and maintaining the steam pressure at 130 pounds, without difficulty It will pull as much as 40 or 50 horses, besides propelling itself Its weight is only $8\frac{1}{2}$ tons The carrying wheels are about 8 feet high and 26 inches wide The steering wheel is 5 feet high and 14 inches wide . It is adapted for plowing, running combined harvesters,

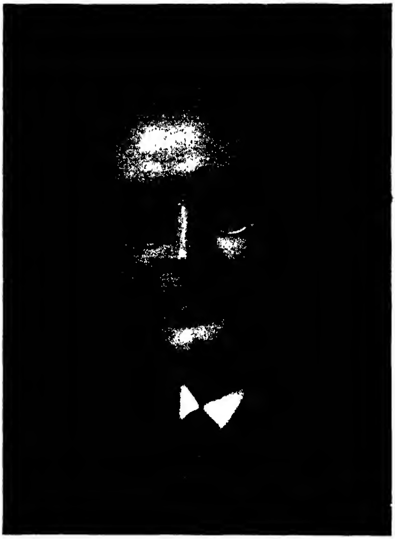


freighting with wagons, hauling saw logs, or pulling of almost any kind, and is suitable for any stationary work, such as running thrashing machines, sawmills, etc"

SPEED AFLOAT—"The torpedo boat *Adler*, constructed in Germany for the Russian Black Sea fleet, is described by the Russian papers as the fastest war vessel afloat, having attained during its trial trip a speed of 26 55 knots The boat is 150 feet long and 17 feet broad, with a displacement of 150 tons Three gunboats, one of which—the *Narghen*—is finished, are being constructed in German shipyards for the Baltic fleet, and these will be almost as fast steamers as the *Adler*"

MUSIC FROM AFAR—"An interesting and really notable musical and vocal entertainment was given recently from New York to a very large audience assembled at the Grand Union Hotel, Saratoga, by means of a 'long distance' telephone circuit running a distance of 180 miles from 18 Cortlandt Street, New York, to Saratoga From Cortlandt Street a circuit had been run to the Madison Square Garden, and the concert being given by the Strauss orchestra was taken in alternation with the other numbers of the programme The orchestral music was listened to at Saratoga by means of sets of hand telephones, and every note was heard distinctly, even to the applause of the audience gathered at Madison Square. Some of the songs and solos and the recitation were heard all over the room at Saratoga by means of a single loud-speaking receiver provided with a large funnel-shaped resonator to magnify the sound"

Personalities in Science



DAVID BURPEE

A TRADITION has grown up in the life of David Burpee, internationally known plant hybridist and seedsman—a tradition centering around a 33-year search for a yellow sweet pea He hasn't found or produced it yet but, oddly enough, has given to the world other improved yellow flowers

Mr Burpee was born in Philadelphia, Pennsylvania, April 5, 1893 He was educated at Blight School, Philadelphia, Doylestown High School, Culver (Indiana) Military Academy, and the Agricultural College, Cornell University His father gave him the choice of Cambridge (England) or Cornell, and young David, who had traveled many times to Europe, paid a special visit to Cambridge before selecting Cornell

David Burpee started on his career to achieve new flowers for American gardens as a youth of 14 and has contributed much to floriculture He has been very successful in producing new strains of petunias, zinnias, marigolds, and calendulas, but has not yet achieved that which started his deep interest in horticulture the production of a pure yellow sweet pea for which his father, founder of the W Atlee Burpee Company, offered him a reward of $1000 To a young schoolboy, this sum looked like stupendous wealth

At the Burpee seed farm at Lompoc, near Santa Barbara, California, young David and his brother, whom he had inveigled into joining the search, trudged up and down, row after row of the 400 acres of sweet peas hoping to find that Nature might have done the trick and turned up a yellow break No luck there, so he avidly read book after book on genetics and plant breeding, obtained seeds of over 150 species of the sweet pea family from all corners of the globe, grew them at his Fordhook Farm near Doylestown, Pennsylvania, and the following summer pollinated hundreds by hand — a back-breaking task Today, 33 years later, he is still trying to produce a yellow sweet pea.

At 21, he was assistant to his father in their seed business and a year later became General Manager Three years after first joining the company, he became President when it was incorporated in 1917 Among his other interests, he is Director of several banks and trust companies, has served as vice president and president of the American Seed Trade Association, is Vice President, National Sweet Pea Society of Great Britain, Honorary Life President of the Canadian Society of Philadelphia, director or trustee of several hospitals, horticultural societies, and the like, and is a member of prominent clubs

"Flowers have fashions just like clothes," Mr Burpee says "In the old days, gay blossoms forming a hodge-podge of color were the garden vogue but, today, we want color in mass whether it be soft pastel shades or vivid hues, and it is the production of these 'fashion flowers' that keeps the hybridists and plant breeders busy "

David Burpee was the first to produce a big marigold with truly odorless foliage, the first double red hybrid marigold, and the first double nasturtiums in all colors

The first super-double nasturtium, having 75 petals, was another of Mr Burpee's floral successes He purchased seed of the original Golden Gleam, grew them at the company's Floradale Farm, Lompoc, and crossed them with 40,000 other nasturtiums in the hope of producing a new flower Finally he was successful and the first seeds and cuttings—so heavy was the demand that the supply of seeds alone was inadequate—sold for 10¢ each which was an unheard of price for nasturtiums.

What a vast story of adventure, hard work, and disappointment lies behind each of Mr Burpee's floral achievements! His aim has always been to work with and produce fool-proof seeds that would grow in any garden rather than to experiment with rarer flowers with which the average gardener would be apt to have great difficulty.

A HAIL OF LEAD FIRE
OVER ENGLAND

THIS British "Hurricane" fighter is a formidable opponent. Eight Browning guns, mounted in the wings, are aimed by "aiming" the plane, and fire a total of 2400 rounds in 10 seconds. Speed of the plane is 340 miles per hour (recently increased 10 percent); ceiling is seven miles: and cruising range 600 miles.

96TH YEAR · SCIENTIFIC AMERICAN · SEPTEMBER 1940

SCIENCE IN INDUSTRY

COAL TAR BEGAN IT

Vast Increase in U. S. Organic Chemicals Industry

CHARLES M. HACKETT

In 1919, the Committee on Finance of the United States Senate weighed a serious question: should the government "promote the establishment of the manufacture of coal tar products in the United States." Before the group appeared a distinguished witness, Dr. Marston Taylor Bogert, senior professor of the Department of Chemistry at Columbia University.

Dr. Bogert painted no rosy picture. He described organic chemical research in this country at that time as being "on a fragmentary basis." Further, he noted that such a development would have far-reaching consequences in bolstering the national defense.

"Gentlemen," he testified, "I have no hesitation in saying that a well-developed synthetic dyestuffs industry is absolutely necessary for the security of our country."

In two decades the significance of that testimony has re-shaped the American industrial pattern.

Dr. Bogert did not mean that America had no chemical industry. As early as 1865, the value of chemicals produced in this country was about $60,000,000. In 1910, the United States produced three times as much sulfuric acid as Germany, and twice the alkalies produced by England. The value of chemical products in 1914 was quoted by the U. S. Census of Manufacturers as in excess of two billion dollars. Satisfactory progress had been achieved in acids for the steel and fertilizer industries, and other so-called "heavy chemicals."

The noted professor's concern was caused by the fact that the World War, then just concluded, had disclosed a woeful lack of both the knowledge and manufacturing facilities required to produce many essential materials that could only be made by greater knowledge and application of organic chemistry.

The situation described by Professor Bogert led to an intensive program of chemical research which, in less than a quarter of a century, has produced one of the greatest organic chemical industries in the world, and which still seeks new knowledge and new ways of applying the products of this industry to the everyday lives of millions of people in this and other countries. Evidence of this continued search may be found in the report that the American chemical industry spent an estimated $20,000,000 on research in 1937, alone. Only the steel and petroleum industries are said to provide for comparable expenditures.

Organic chemistry has synthesized the dyes, textile fibers, pharmaceuticals, flavors, perfumes, and scores of similar products which have caused some to designate the present as the Chemical Age.

This industry is a substantially 100 percent American development. American initiative has directed its course, the methods employed in building it up were American methods, and it has been financed by American capital. This does not mean that we have not profited from foreign developments and foreign experience. We have, and gratefully acknowledge it.

The organic chemical industry now ranks close to the top of American enterprise. It has promoted the growth of new industries and stimulated many older ones. It has brought the good things of life to more people, and it has bulwarked national self-sufficiency.

No one alert to contemporary developments need be told of chemistry's importance. But the *rate* of growth is impressive to the most casual observer.

In 1914, we made only about 10 percent of the dyes we used, and even that small amount was based on imported intermediates. In 1938 we produced some 96 percent of the dyes consumed in this country, and had an export balance of more than five million pounds.

Since 1919, when organic chemicals manufacture was in its infancy here, countless new products have been developed. Of those known in 1919, U. S. production has increased steadily. The average *annual* increase in flavors and perfumes between 1919 and 1937 was 29 percent, in photographic chemicals, 22 percent. Total coal tar finished products showed an average annual rise of 18 percent. In the 17-year period 1921-1937, production of non-coal tar organics—including synthetic methanol and other alcohols, acetic acids, acetone and various amines—showed an average *annual* growth of 685 percent!

Americans past the age of 30 may grasp some idea of the significance of the above figures if they compare the increases with that of the automobile industry, whose products they have seen filling the streets with more and more cars year after year, and for which they have watched broad ribbons of highways built from coast to coast. Yet the average annual increase in automobile production between 1919 and 1937 was but 9.6 percent, as compared with the spectacular rise in various organic chemicals. That the rise has been less noticed may be accounted for by the fact

that the products of chemistry, for the most part, remain hidden and do not add to traffic problems

With this accelerated production have come price declines as phenomenal as manufacturing increases The average price of coal tar products dropped between 1919 and 1937 from $1 02 a pound to 41 cents, coal tar dyes from $1 07 to 55 cents Flavors and perfume chemicals fell from $2 27 to $1 02 Phthalic anhydride, used in the manufacture of alkyd resin finishes and certain dyes, is available today at 15 cents a pound, although it was around $6 00 a pound in 1917 Production of this important industrial chemical during 1939 is estimated at 60,000,000 pounds

Certain inorganic chemicals used in making organic products have likewise enjoyed important price reductions During the 1919-1937 period, sulfuric acid dropped in price about 31 percent, caustic soda nearly 45 percent

These advances in production and reduction in prices have affected the lives of virtually every American, and have created a high degree of dependence upon organic chemicals They pervade nearly every aspect of contemporary life, and fundamentally affect our national economy

This development stretches into the nerve centers of the country's economic system It has provided jobs directly for thousands of workers—how many thousands it is difficult to compute Countless additional employment avenues have been opened up by providing raw materials for many new industries Dyestuffs, pharmaceuticals, and plastics provide conspicuous examples Some products in these classifications have been made for many years, but in a larger sense they represent new industrial entities

Plastics of the nitrocellulose type have been known and employed since 1869 (Celluloid), but the modern plastics industry with its versatile performances could not operate without a plentiful supply of organic chemicals Acetic acid, synthetic camphor, and phenol could be cited Formaldehyde and urea, a gregarious pair useful either in harness or singly, are found in a variety of well-known plastics

Plant where several well-known organic chemical products are made — du Pont plant at Deepwater, New Jersey. Note many buildings

The industrial importance of camphor may be emphasized by its use in motion picture film, which demands more than a half-million pounds a year Camphor was controlled by a Japanese monopoly only a few years ago, and under Japanese domination the price of refined natural camphor went to $3 55 a pound in 1920

TODAY refined synthetic camphor is selling for about 60 cents a pound, while the technical grade used in plastics and photographic film sells for around 35 cents American chemists have learned to make camphor from southern turpentine It is of high quality, chemically identical with the product long sacred to the fragrant forests of Formosa The Du Pont Company is supplying more than half the total domestic consumption of this important material

Imported urea cost about 57 cents a pound, corresponding to more than $1100 a ton, in 1920 Now urea of equal or better quality derived from carbon dioxide and ammonia sells at the plant for $85 a ton—and a domestic source furnishes practically every pound of urea consumed in this country.

New materials for making wholly new plastics have been found The sparkling "Lucite" methyl methacrylate plastic with its extraordinary toughness, beauty, and optical properties, is a notable example In fact, the entire modern plastics industry is the precocious child of organic chemistry

Still other organic chemicals, synthesized to meet definite specifications, have likewise aided development of new industries The "Freon" fluorinated hydrocarbons afford an excellent illustration of such made-to-order products Not only is "Freon" an excellent refrigerant, but it is non-poisonous, non-explosive, and non-flammable This combination of properties lent great impetus to air-conditioning This new type of refrigerant is widely used today in the air-conditioning units of theaters, hotels, office buildings, and railroad trains

Of outstanding importance in the manufacture of rubber goods are the new and improved organic accelerators, anti-oxidants, sun-checking inhibitors, and agents which nullify the destructive influence of slight traces of copper The fact that today's automobile tires give some 25,000 miles of service in comparison with 5000 miles only a few years ago is due in no small degree to the use of such organic rubber chemicals

Synthetic rubber-like materials developed within the past few years have been accorded a hearty welcome by fabricators of rubber goods Although different in composition from natural rubber, the physical properties of certain of these synthetic materials are similar to those of rubber At least one of these new materials—neoprene—has qualities not found in the natural product, including resistance to oils, greases, chemicals, sunlight, and oxygen It fills hundreds of needs that natural rubber cannot fill, and this chemical rubber is based on abundant domestic raw materials — coal, limestone, and salt

Discussion of the role of organic products would be incomplete without reference to rayon This country produced some 288,000,000 pounds of rayon in 1938, the more recently developed products such as "Vinyon" and the polyamides known as nylon open promising horizons.

The work that organic chemicals have performed in the automobile

industry has become classically familiar, although it often is not thought of in terms of chemistry Nitrocellulose lacquers, developed about 1921, represent one of the greatest contributions By cutting down finishing time with orthodox enamels, durability had been sacrificed, but the nitrocellulose lacquers are both quick-drying and durable

The recent development of polyvinyl acetal plastics has a direct bearing on the automobile industry For many years safety glass for windows and windshields was made with an interliner of nitrocellulose or cellulose acetate plastic, but last year it was found that an interliner of a certain type of polyvinyl acetal plastic has definite advantages over the cellulose plastics, This new type of plastic is extremely tough and elastic not only at ordinary temperatures, but at low temperatures as well It is for this reason that the polyvinyl acetals—products of the organic chemical industry—make possible the safest safety glass ever made

Synthetic organic chemicals find numerous important applications in the manufacture and use of petroleum products Cracking processes have had the effect of doubling national oil reserves as far as gasoline is concerned On the other hand, cracked gasoline in storage has a tendency to develop gums which lead to clogging of motor and fuel lines Certain organic chemicals, however, have substantially eliminated this tendency

In the manufacture of perfumes, materials known as "fixatives' are used One of their functions is to make the odor more lasting Until a few years ago, all fixatives were of animal origin, such as the musk from a species of deer in Tibet The characteristic ingredient of natural musk, if it could be had in a perfectly pure state, would probably be worth its weight in gold several times over Within recent years, however, synthetic musks have been developed, and at least one of these new organic compounds is substantially identical with the characteristic ingredient of natural musk These sell at a fraction of the cost of the natural product.

Stills used in making synthetic camphor from CO_2 and ammonia

To the enrichment of American harvests, the organic chemical industry has made many notable contributions Urea, a synthetic nitrogenous chemical, not only finds application in plastics, but also as a fertilizer ingredient Organic mercurials are being used successfully for the control of various plant diseases caused by fungi, and the long-chain alkyl rhodanates are combating the ravages of sucking insects on certain agricultural crops

Nowhere have organic chemicals played so vital a role as in the prevention and cure of disease

Not long ago a little girl was stricken with a much-dreaded streptococcus infection Her terrified parents were astonished to see their physician view the danger calmly

"Now," he said, "we have a new weapon for such infections—sulfanilamide'

The little girl got well

Although introduced into the materia medica only a few years ago, this coal-tar derivative has already saved the lives of thousands suffering from "blood poisoning," peritonitis, streptococcic sore throat, puerperal or childbirth fever, meningitis, and other dangerous maladies resulting from streptococcic infection

Fundamental research in such sciences as chemistry, physics,

Packing synthetic camphor as it leaves the flaking machine

biology, and pharmacology are believed to hold the key to the great medical developments of tomorrow. Chemotherapy, itself fully as important as the first work of Pasteur's laboratory, is nurtured by the organic chemical industry A long list of new organic compounds awaits the attention of the research workers in pharmacology and experimental medicine Pharmacological development will continue to be supported to an increasing degree because of the chemical manufacturing industry's growth

The research chemist has established the constitution of certain of the hormones These little-understood secretions of the ductless glands in some degree affect the functioning of the mind as well as regulate the chemical reaction of the body Some of these "chemical messengers" have now been synthesized in the laboratory Developments in this field offer promise of cure for certain mental ills which have baffled medical science for ages

• • •

Breath of Industry

Oxygen Torches Cut, Condition, and Prepare Steel; Drill Stone and Concrete

HAROLD LAWRENCE

The air we breathe is being used in some mighty strange places More particularly, the oxygen of the air supports many industries just as it supports us Steel is being conditioned with the aid of oxygen Steel plate edges are prepared for welding by this same gas Precise shapes are being cut with oxygen, replacing a multiplicity of machine tools Steel structures are prepared for painting with the oxy-acetylene de-scaling tool And both concrete

Oxygen flame rapidly cleans steel surfaces for painting

and rock are being drilled in this same manner

Most of the oxygen being used in these new industrial operations is separated from the air Yet in some cases where there is an outlet for hydrogen, too, as in the packing industry, oxygen is obtained from water Whatever the source, the utmost in purity is demanded The oxygen used for cutting must be every bit as pure as that used in hospitals, 99 5 percent or more pure If it takes 100 cubic feet of 99 5 percent pure oxygen to do a specific cutting job, it will take 160 cubic feet of 97 5 percent pure oxygen to do the same job And that's the very reason that causes engineers, cost accountants, and production men to watch the purity of the oxygen with an eagle eye

One of the most spectacular applications of oxygen has taken place in the steel industry Here, conditioning of blooms and billets has always been a costly and slow operation When steel is poured from the ladle into an ingot mold, some splashing occurs Such splashed steel sticks to the mold walls and leaves a scab on the rolled product Furthermore, cracks and laps and laminations as well as other surface defects may show up during the rolling of the steel So just before the final rolling operation, inspectors go over every inch of the steel surface looking for these defects, finding them, and marking them for removal There on the billet dock—where semi-finished steel is inspected—the skin of the steel is given a beauty treatment

No doubt few of you have ever stood on the billet dock of a steel mill listening to the roar of hundreds of chipping guns The roar ebbs and flows and grows until you feel sure that your ear drums will burst If you have never heard this awe-inspiring sound, you never will The almost soundless hiss of a small stream of oxygen has silenced the roar forever Chipping guns have been scrapped Men s nerves aren't jarred by bucking air-hammers all day long Steel conditioning costs are down Production speeds are up And, despite the tremendous quantities of oxygen being removed from it every day, the air still remains one-fifth oxygen

Perhaps one might think that the introduction of flame scarfing to replace slow chipping operations on the billet dock satisfied the steel men No, the increased speed and lower costs made these men eager for more improvements Out of the oxygen research laboratories they came No longer did the steel blooms and billets have to cool in endless rows and piles before getting their skin treated Now the glowing steel thunders from the hot shears to a peculiar looking device whose many-fingered arms nestle into place A control is operated Hundreds of jets of oxygen open, bathing the unhealthy skin from the steel

The octopus device draws back its tentacles The steel rolls and bounces down the roll table to the reheating furnaces where it will be reheated for the final rolling operations Note that the steel can be charged into the reheating furnaces hot instead of cold, the heat locked up in the steel isn't wasted Thus fuel consumption per ton of steel produced was reduced a little more The process of removal of slight surface imperfections, known as steel conditioning, was modernized. Production no longer remained at the mercy of the snail-like conditioning operation Pure oxygen changed all that

But the steel industry is not the only industry to benefit from research into the industrial application of oxygen When boiler and pressure vessel manufacturers progressed from riveted to welded construction, old-time boiler-makers hung up their riveting guns with a sign of relief The ungodly clatter was over A good riddance, too. But along came construction codes such as that sponsored by the American Society for Mechanical Engineers demanding the removal of the unwelded zones between the two sides of a weld, these zones being necessary to hold the molten metal temporarily

Down came the air-hammers This time they would be used to drive diamond-point chisels Back came the racket and the roar—the same unnerving noise that had made such a bedlam of the steel billet dock But not for long

Oxygen men were not ready to ring down the curtain on another possible application of their equipment. So flame-gouging was born The same oxy-acetylene preheat flames backed up by a low-pressure stream of oxygen, delivered through a special nozzle, would do the work of the diamond-point chisels Not only would the oxygen do the work, but best of all, it would do it both faster and cheaper So, again, away with clang and clatter! Quiet oxygen would soothe frayed nerves! And lo and behold, overall plant efficiency increased almost 15 percent in one plant—attributable to noise elimination alone

As the pressure vessel industry grew, demands were made for heavier and heavier plate Economical welding procedure demanded U-shaped welding grooves Until quite recently the only tool for making these welding grooves was a plate planer About the only objection some shops had to the installation of a plate planer was the cost For a good plate planer costs more than eight times as much as the most expensive oxygen bevelling equipment. Back to their researches went the oxygen men And out of their work came efficient oxy-acetylene plate edge preparation at a cost within the

Steel is cut cleanly, rapidly with the oxy-acetylene torch

reach of all When the oxy-acetylene torch completes its work, the plate edges may be placed together to form a perfect groove

Increasing temperatures and pressures placed great responsibilities upon the shoulders of pressure-vessel manufacturers To prove the quality of the welds they made, they pressed into service the X-ray As was anticipated, the X-ray pictures disclosed infrequent defects

Photos Air Reduction Sales Co

Using a template guide, an oxygen torch cuts machine parts

in the welds Such defects were chipped out—a slow and laborious process Luckily, the same tool that was used for gouging the unwelded portion of a seam and for plate edge preparation, might be used for removing these defects

For some time, the use of the oxy-acetylene torch for severing steel has been common knowledge Even the adaptation of this tool to rough-shape cutting has been known by many But the development of precision tips, that eliminated all other finishing operations involving the use of machine tools, came quite recently. Here the perfection of precision nozzles led to unbelievably close tolerances How close? Well, from three-thousandths of an inch in one-inch plate to slightly more than three-hundredths of an inch in six-inch plate

Meanwhile, the men in oxygen research saw another opening for their tools. For many years, the painting industry had been preaching the importance of the proper preparation of steel for painting. Sand-blasting, pickling and chipping had all been used with success. Each process had its advantages and disadvantages, of which the latter were mostly concerned with the slowness of the process. A special tip emerged from the development division to use oxygen in combination with acetylene for rapid and certain flame descaling By quickly raising the scale on the surface of the steel to a high temperature, the descaling torch turned the trick Differential expansion of the oxide skin and the steel below caused the scale to fly off The scale-free dry steel that remained was ideal for painting

Now we come to one of the most recent milestones on the oxygen road of progress hole-drilling in both stone and concrete Rock is quarried by drilling blasting holes in which dynamite is used to blast huge blocks of material out of the formation in which they are found. Heretofore this drilling has been accomplished by cumbersome and expensive machinery. Once more the operators might have struggled along with both heaviness and cumbersomeness if the machines hadn't been so slow Then along came a special oxy-acetylene torch and tip that drilled the holes in rock with speed Although speed ruled, I must admit that the lighter equipment and greater economy which were thrown in for good measure helped to swing the balance in favor of the flame process

Frequently holes must be drilled in concrete This stubborn and unyielding man-made rock is conquered slowly with a star drill and pneumatic gun Powdery concrete emerges from the hole so slowly as to tax the most angelic patience No rapid drilling of concrete was ever possible, that is, not until the advent of oxy-acetylene drilling

Both stone and concrete contain water. In flame drilling, the concentrated heat of the oxy-acetylene flame turns this water to steam The steam, trapped as it is on all sides, explodes And the hole is drilled not only with speed but also with economy I'm not going to mention speed or economy again By this time you must know that these two words are synonymous with oxygen processes

Ever notice a runner at the end of a long race? He is fighting for oxygen to replace that which he has burned up while running Not so industry Industry is breathing easier in its oxygen tent This ubiquitous gas has eased the struggles of industry in many places.

Nothing has been said here about welding, brazing, or soldering with the oxy-acetylene torch. Nor has anything been said about flame hardening or flame softening. But why go on? Even as I write, the oxygen men are putting the finishing touches to developments that will make the story of oxygen even more unbelievable

• • •

HOT-SPRAY

Lacquer Finishes Applied Faster - And at Less Cost

In virtually every system of surface finishing, the ultimate object is to obtain the greatest degree of permanent protection with the least amount of labor and material The cost of the finishing process is proportionate to the amount of solids on the surface when the finishing operation is completed

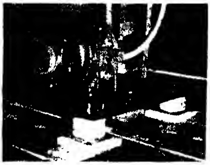
In strict keeping with these basic principles, the new P&S hot-spray lacquer system produces, in a two-coat finish, the solids ordinarily obtainable in a three-coat cold lacquer finish The heat employed in this machine gives spraying consistency without the use of thinners or solvents Consequently, with this equipment, the manufacturer claims economies in amount and cost of material used, application time, drying time, and labor and handling costs

SPRING ISOLATOR

Machine Mounting Damps Noise and Vibration

A new, easily installed vibration isolator, designed as an economical means to control machine vibration and reduce the resulting noise, was recently announced by Johns-Manville This device, known as the J-M Controlled Spring Isolator, was developed for use on the bases of motors, generators, pumps, ventilating fans, and similar equip-

Sectional view, spring isolator


Motor on spring isolators

ment where vibration and excessive motion create noise and tend to wear out machine parts and damage connections as well as to crack the supporting walls and floors

The working parts of the unit consist of a coil spring and a rubber load pad, which support the equipment and isolate vibration—and an adjustable rubber snubber inside the base, which controls excessive motion

The isolator is built to take care of horizontal and torsional as well as vertical vibration It is efficient for the low frequency vibrations resulting from slow speeds and from many operations involving reciprocal motion The load pad is designed to overcome any high frequency vibrations

The device is made in two sizes Light duty, for loads from 50 to 190 pounds per isolator, and heavy duty, for loads from 250 to 720 pounds per isolator Heavy machines may be isolated by clusters of the units The loaded overall dimensions of the unit are six by six inches by approximately 3¾ inches high It is enclosed in a metal jacket which protects the rubber parts from oil and light

FACTORY RUBBER

New Synthetic Useful For Tires

On page 125 of this issue, Philip H Smith touches upon the so-called synthetic rubbers, indicating that we are not yet in a position to replace natural rubber with the synthetic variety The newest of these synthetics, which is equal or superior to natural rubber in many of its properties and can be processed and vulcanized like the natural product—in making tires, for example—is claimed by the developers to be capable of radically reducing our dependence upon natural rubber which must be imported Of course, this factory product is more expensive than latex rubber and only in a great national emergency would sufficient plants be constructed to make it in large quantities

The basic raw material for this new factory-made rubber, which has been named Ameripol by the B F Goodrich Company, is American petroleum Dr Waldo L Semon, its discoverer, explains that the petroleum is broken down by the cracking process to a mixture of simple molecules From this mixture can be separated a gas which, under pressure, liquefies to give butadiene This is mixed with other ingredients prepared from natural gas and air and then made into a milky emulsion, using soap produced from American agricultural sources Upon heating and agitation, these ingredients react to form an emulsion of synthetic rubber, which is similar to the latex obtained from rubber-producing trees From here on, the process of obtaining a sheeted rubber is quite like that used for natural rubber The latex is coagulated with acid, producing a curd This is then sheeted and dried to give the Goodrich synthetic

PROGRESS

Hand of Research, a Midas Touch on Machines

For the benefit of all those who may be critical of scientific research in any respect, we present an accompanying photograph showing four versions of the lowly washing machine No women accustomed to the 1940 model would ever be content to use again the 1919 model Yet despite the significant story told in this group picture of four machines, there are still some people who claim that new models are built solely for catch-penny purposes—to exploit the consumer

Scientific research made possible the vast improvements shown in this group picture, not the least part of that improvement being the reduction in price by about one half for a modern machine that does better work than its earlier prototype

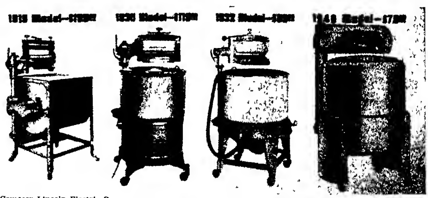
MOLDED AIRPLANES

New Pressure Tank Ordered For Production

A super-size molding tank for so-called plastic airplanes and parts has been ordered for the Duramold Aircraft Corporation, a subsidiary of Fairchild Engine and Airplane Corporation The tank, 10 feet in diameter and 28 feet long, will be installed in the Grand Rapids plant of the Haskelite Manufacturing Corporation, co-owners of the Duramold process The quick-acting door of the tank alone weighs 13 tons

The so-called plastic airplanes are not, as is generally thought, made by pouring a plastic into a hollow mold, but rather are made of wood fibers in the form of thin veneers bonded together with plastics under heat and tremendous pressure [See Scientific American, July 1939 —*Editor*] By utilizing and preserving the tremendous natural strength of properly arranged wood fibers, a new material is obtained, which is not only stronger and lighter than pure plastics, but one that compares favorably with riveted aluminum alloys Duramold engineers emphasize the fact that all the raw materials used in plastic airplanes are available in large quantities in this country

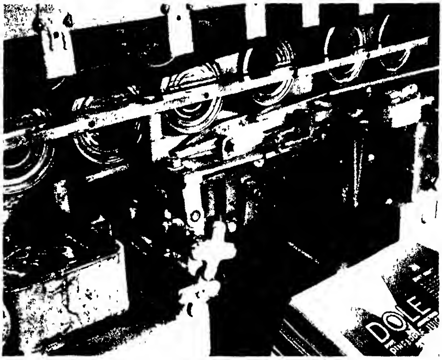
Duramold Aircraft Corporation was the pioneer in developing synthetic materials and processes for molded airplanes and flew a plane,


Courtesy Lincoln Electric Co

One of many examples of industrial progress brought about by research

with a molded fuselage, over two years ago. Production molded units made by the Duramold process are now in use in the Fairchild Army training plane and on planes of one of the major airlines.

According to *Modern Plastics* magazine, four aircraft companies are now working intensively on the problem of molded airplanes, two major research institutions are investigating various phases of the subject, and the Army Air Corps and the Navy Bureau of Aeronautics are closely watching all developments as well as carrying on tests in their own laboratories.



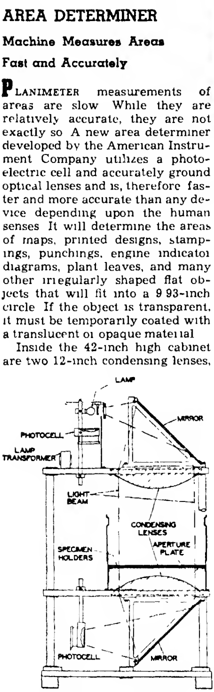
Can labeler; paste (left), label pick-up (center), label pile (right)

AREA DETERMINER

Machine Measures Areas Fast and Accurately

PLANIMETER measurements of areas are slow. While they are relatively accurate, they are not exactly so. A new area determiner developed by the American Instrument Company utilizes a photo-electric cell and accurately ground optical lenses and is, therefore, faster and more accurate than any device depending upon the human senses. It will determine the areas of maps, printed designs, stampings, punchings, engine indicator diagrams, plant leaves, and many other irregularly shaped flat objects that will fit into a 9.93-inch circle. If the object is transparent, it must be temporarily coated with a translucent or opaque material.

Inside the 42-inch high cabinet are two 12-inch condensing lenses, two diffusing screens, two mirrors, and two photo-electric cells. A galvanometer is used for determining the balance point between the two cells. To operate the machine, after plugging it into a 115-volt socket, the dial on the face of the cabinet is first set at zero by balancing the two cells. The flat object to be measured is then placed between glass plates over one of the lenses. The galvanometer deflects and is then brought back to zero by turning the dial. Finally, the dial reading is multiplied by five to obtain the area in square centimeters.



Set-up of area determiner

LESS TIN

New Tinning Process Saves Vital, Imported Metal

TIN is one of those vital raw materials which the United States must import. Although this country uses a relatively small amount—about 40,000 tons yearly—to make tin cans, there is not yet a completely satisfactory substitute for it. Therefore, if our imports from the Dutch East Indies and the Straits Settlements were cut off, an enormous canning industry would feel the pinch of the war.

Professor Colin G. Fink, of Columbia University, from whose laboratory many metallurgical and metal plating processes have come, has now developed a process which permits much thinner tin plating on the iron sheet that makes the tin can. According to recent reports, this process would save half the tin now used for this purpose. His new process involves electro-chemistry instead of dipping.

RAPID LABELER

1400 Pineapple Cans Labeled Per Minute

THE fact that up to 1400 cans are labeled per minute at the Hawaiian Pineapple Company's cannery in Honolulu is a record made possible by improvements on standard can-labeling machinery. All of the machines were originally standard Knap machines, but have been re-designed to raise the speed as much as 50 percent over that at which the labelers are usually operated.

The Hawaiian Pineapple Company, growers and packers of Dole products, evolved a new design to speed up the operation of the original labeler. The pick-up paste pan has been fitted with two sets of rollers, both machine driven. One rotates clockwise, the other counter-clockwise. One set of rollers is grooved like a pulley, while the other set is pointed and operates within the groove of the first set. The pointed rollers are on a shaft made adjustable to increase or decrease the space between the meshing rollers. This permits the application of either lesser or greater amount of pick-up

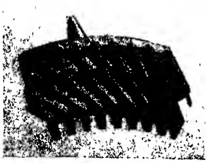
paste. The rollers are self-cleaning

Another improvement was the introduction of a new method of feeding the cans into this fast moving machine Trays of cans are upended so the cans roll by gravity onto a belt which passes them in an almost uninterrupted stream across the paste pan rollers To supply labels to the machine, a slip drawer, which falls back to a slightly out-of-plane position, is filled with labels while the machine is running When the labels in the machine have been used, this slip drawer is simply pushed forward into the machine after the table has been lowered to receive them The drawer is then removed and the machine continues its operation with practically no shutdown

ROTORS

Improvement in Induction Motor Construction

OFFERING the advantage of longer motor life with less maintenance, a new type rotor construction announced by General Electric makes possible the use of cast-aluminum rotors in the larger sizes of double-squirrel-cage motors for high-starting-torque, low-starting-current service Called the "Valv-amp" rotor, it makes use of a unique shape of rotor slot and a special method of assembling rotor punchings to control the flow of starting current As a result, without the use of a switch or other moving parts, current is permitted



Section of cast aluminum rotor

to flow in the outer squirrel-cage when the motor is started, thus producing high starting torque Then, when the motor comes up to speed, current is allowed to flow through the entire rotor "winding," resulting in excellent running characteristics

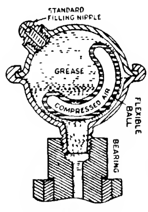
Of the two conventional methods of double-squirrel-cage-rotor construction—that is, casting the conductor bars and short-circuiting rings integral, or joining them by brazing—the former method is by far the more satisfactory because it is a simpler operation, with smaller chance for human error, and results in a more compact, uniform product However, until the Valv-amp development, it has not been practicable to cast double-squirrel-cage rotors in the larger sizes

The Valv-amp development, however, allows the construction of larger cast-rotor motors which inherently combine the advantages of the double-squirrel-cage motor, such as high starting torque, low-starting current, and excellent running characteristics, with advantages of the conventional cast-rotor motor—simplicity of construction, long motor life, little maintenance, and permanence of electrical characteristics

PRESSURE LUBRICATOR

Flexible Ball of Neoprene Uses Compressed Air

A CONTINUOUS, positive flow of lubricant to the wear surface of bearings while they, or the shafts,



are in motion is assured by a new pressure lubricator which is permanently attached to the lubrication passages. This device utilizes compressed air, stored in a neoprene ball, to force lubricant to each individual bearing as it is needed by that bearing

The lubricator consists of a steel shell, designed to withstand high pressures, inside of which is a hollow, flexible neoprene ball The shell is equipped with a standard grease fitting and a pipe-threaded outlet that screws into the standard lubrication passage

When grease is forced into the lubricator by a pressure gun attached to the grease fitting, it collapses the neoprene ball against the pressure of the air inside of it, thus compressing this air and storing up energy After the lubricator has been filled under high pressure, the grease flows through the bearing rapidly with a flushing action until the pressure within the lubricator drops to where it balances with the resistance of the bearing to passage of lubricant When this static condition has been reached, further lubricant is forced to the bearing only when the bearing is in motion The pressure balance is upset only when the bearing or the shaft is moving, causing loss of lubricant and the consequent need for replacement of the grease or oil

The flexibility of neoprene and the ability of neoprene compounds to resist the passage of gases were two principal reasons for the selection of this material for the ball In addition, the use of neoprene was dictated by other conditions of service—the lubricators must be effective in cold and hot weather, and they must handle all types of lubricants without appreciable deterioration of any of the parts necessary for their operation —*The Neoprene Notebook*

EYE ACCIDENTS

High Toll of Industrial Eye Accidents

ALTHOUGH safety engineers have long inveighed against the carelessness of workers who will not use the prescribed goggles when doing

dangerous work, that carelessness continues It takes a heavy toll. The American Optical Company emphasizes the cost with the accompanying photograph, their caption saying· "It would take all the artificial eyes in this basket, and more too, to replace the 2000 eyes lost annually in eye accidents."

Such accidents cost American industry approximately $37,000,000 yearly in medical expenses and compensation.

INDUSTRIAL TRENDS

CONTINUOUS CASTING

REVOLUTIONARY changes are taking place in the hot handling of metals. During the past few years the metallurgist's century-old dream of producing billets, sheets, and strip direct from the molten metal in a single step has materialized. Billets of copper, aluminum, and magnesium alloys are being produced commercially right now and it appears that steel will soon be added. You're unlikely to hear about this because the art develops slowly, without publicity of any kind, and in some instances with absolute secrecy.

Actually, the process is one of continuous casting. In this country and in Europe there are mills casting ingots and billets of ferrous and non-ferrous metals on a 24-hour basis to prove the practical nature of the method. A New England producer is now casting over one million pounds of 7⅞-inch brass rounds weekly with a single machine, and it is possible to cast continuously billets up to 20 inches in diameter.

There are half a dozen systems in operation, commercially and experimentally. They differ as to technical details rather than as to basic principle. The molten metal flows from a holding furnace into molds which are jacketed for cooling, then, as the billet comes from the mold, it is cooled by sprays and passes on down to a cut-off saw or flame which cuts it into desired lengths. While the processes are very simple, there have been many difficulties to iron out, because so much care has to be given to temperature control, operating speeds, and molds.

Speed of production is the great achievement. According to the system, kind of casting, and its size, output may vary from 10 inches to 7 feet per minute, and these speeds are likely to be raised with further experimentation and experience.

IN STRIP FORM

To anyone familiar with rolling mill practice, the production of sheet and strip by continuous casting is more dramatic than the turning out of billets. Instead of employing multiple passes through rollers to reduce a chunk of metal to the form of sheet or strip, a single pass of the molten metal will produce thin strip (about 0.02 of an inch in diameter) of eight-inch width at the rate of 500 and more feet per minute.

There is insufficient space for relating the experiments and heartbreaks leading to ultimate success in continuous casting. It is sufficient to say that it is used to handle non-ferrous metals and more recently has demonstrated the capacity to handle high chrome, high carbon, and spring steels. There's no doubt but that it can produce tin plate, but it has yet to prove that it can outmode the great continuous rolling mill for production of automobile sheet.

Enough experimental data have been assembled to warrant the forecast of further triumphs. It is very likely, for example, that the continuous casting of tubing is not far off. This would be accomplished by inserting a stationary mandrel in the forming mold. It is also likely that the new practice will prove valuable for handling stainless and other high alloy steels because of the reduction in scrap loss.

EVERYTHING BUT THE SQUEAL

Do you recall the time honored phrase that the meat packing industry utilized every part of the hog but the squeal? Well, that's literally true, but that is no indication that the industry has reached the end of the utilization goal. The industry has shown great ingenuity in developing outlets for all the various packing by-products, but the application of science is going to find still more valuable uses and thus create vast changes for the industry and its dependents.

I could tell you that the various glands are used for pharmaceutical preparation of hormones, that the livers of calves are used in the preparation of soluble extracts to combat anemia. It might interest you to know that gall stones, found in some cattle, are shipped to the Orient where they bring as much as $150 per pound for use as amulets, but it is more to the point to tell of recent events and forecast some more.

It has just been announced that the juice of the tropical guaicum tree, used in small quantities, will prevent the oxidation of lard, so that it can be kept without refrigeration and its nutritive values preserved without chemical change. This is a discovery of great value. The lard market has shrunk under the competitive onslaught of the hydrogenated vegetable oils, known to you under various trade names, and more recently the export market has been subjected to fire. It has been vital to the live-stock raisers and to the packers to revive the market.

Lots of work is being done with gelatine. Notably, several universities are studying its fatigue-relieving effects under controlled conditions. Gelatine already has a substantial market to capsule a host of products, but it can benefit from a bigger one. Blood goes into the manufacture of adhesives and has been employed to bond cheap plywood. I venture to say that fundamental studies into the nature of animal blood will be made to give it a value which at the moment is very low. Certainly scientific progress is being made in the packing industry, and I hope to be able to announce another important discovery at an early date.

STRATEGIC MATERIALS

War has unquestionably dislocated trade and shut off the flow of commodities between this country and a large and important section of the world, but as to ultimate effect upon American industry, one man's guess is nearly as good as another's.

Viewing the kaleidoscopic events, this much can be said: Our situation in supplies of strategic materials is much better than it would have been had similar upset conditions existed a few years ago. (See Scientific American, March, 1936.) The rubber problem seems pretty well licked by *ersatz* developments, although over-night production in any quantity is out of the question. We could get tin from Bolivia, but we lack the smelters necessary to refine it. It's more likely that the need for tin as a plating agent would be met by substitutes, leaving available supplies for more essential items. A possible substitute is black steel plate, coated with lacquer, another is aluminum, used as a plating.

To these chemical contributions to self-sufficiency can be added substitutes for fulminate of mercury in detonators, chinacrin and plasmochin to replace quinine, and they are talking up nylon to replace silk in powder bags and parachutes.

—Philip H. Smith

First Aid For Burns

Application of Tannic Acid is Procedure That Has Received World-Wide Recognition

CHARLES A. McAVOY
Burroughs Wellcome & Co (U S A) Inc

THE standard first aid for burns in the United States Navy is an aqueous jelly containing 5 percent tannic acid and 0 5 percent phenol Tannic-acid jelly was adopted by the Bureau of Medicine and Surgery of the Navy after ten years' successful use of tannic acid in the treatment of burns by the leading hospitals of the world

Tannic-acid treatment of serious burns was introduced as the result of work by the late Dr E C Davidson of the Ford Hospital, Detroit Dr Davidson was searching for a coagulant of proteins and most of his early work was with phosphotungstic acid His attention was drawn to the fact that, for many centuries, the Chinese had used a strong decoction of tea in the treatment of burns, he replaced phosphotungstic acid with tannic acid and obtained brilliant results

In 1925, Dr Davidson announced the results of his work His paper led to a world-wide adoption of the tannic-acid treatment of burns and much work and study was carried on by others to perfect the technique Most important was the development of tannic-acid jelly which brought Dr Davidson's discovery into the field of first aid

First aid in serious burns, as in other injuries must be based on the fundamental principle of first aid—"the avoidance of further damage to an injury between the time of the accident and the beginning of medical care "

It is essential, therefore, to consider just what is the most frequent and most serious "further damage" which the first-aid worker must strive to avoid in handling serious burns

A study of current medical opinion establishes four important facts the majority of deaths in serious burns ensue from shock and collapse correct first-aid measures should be instituted immediately after the accident, oily or greasy preparations of whatever type must not be used as first aid, the accepted method of treating burns is the application of 5 percent tannic acid, either as a spray or aqueous jelly

It is stated that 80 percent of deaths from burns are due to shock and collapse The first-aid worker should be fully aware of this danger and his efforts should be to prevent or retard the development of shock during the period between the accident and medical care

In burns, the causative factors involved in shock may briefly be stated as follows loss of body fluids and loss of blood plasma, extreme pain, toxin absorption Medical authorities seem in agreement that shock is the most dangerous factor involved in serious burns and that preventive measures should be taken immediately

SHOCK begins with the injury and the first aid must be immediate in order to be effective Every minute of the time required to transport a burned patient to a hospital adds to the danger of shock During the period intervening between a serious burn accident and medical care, symptoms of shock may develop, retarding the efforts of the physician Tannic-acid jelly should be applied immediately If the injured person is conscious, some fluid should be given The body of the injured person, including the burned area, should be kept warm

The standard procedure in all hospitals is to treat burns with aqueous sprays Most hospitals use sprays of tannic acid or some modification of tannic acid, while others use aqueous solutions of certain dyes In all instances, however, the spray solution is aqueous and depends on penetration for its therapeutic value If preparations containing oils or greases have previously been applied as first aid, the oils and greases must be removed with solvents before the aqueous spray can be used In cases where the burn covers a large area, or the patient is in shock, the "scrubbing" of the injury becomes a serious factor.

The disaster to the airship *Hindenburg* caused many serious burns to be treated at the hospitals at Asbury Park and vicinity. Dr O. R Holter, of Fitkin Hospital, Asbury Park, New Jersey, wrote in the September, 1937, issue of the *Journal of the Medical Society of New Jersey* regarding his experiences with serious burn cases following the wreck In the course of his article, Dr Holter said "The use of oils and ointments of various kinds, home and proprietary remedies, in the treatment of second and third degree burns is to be severely condemned "

The tannic-acid treatment of burns introduced by Davidson has revolutionized both hospital and first-aid procedure in the case of burns. Philip H Mitchiner, M D , M S , F R C S , in his excellent article, "Treatment of Burns and Scalds," (*British Medical Journal*, January 1, 1938) points out that, while the value of tannic acid in burns is due to its coagulating properties, it is important that the solution should have a penetrating action as well Tannic-acid solutions of 5 percent or less penetrate deeply, so that all of the damaged cells are coagulated and the danger of a superficial coagulum (which permits toxin absorption from the deeper uncoagulated tissue) is avoided

Treatment with tannic-acid spray, however, must always be under optimum conditions The patient must be kept warm, the injury kept warm under a heat tent, and the solution sprayed on must be warm Spraying must be repeated frequently for hours until the coagulum is completely formed

Sub-optimum conditions, however prevail at the scene of an accident involving burns Under these conditions, it would not be possible to maintain the patient and the injury warm during the treatment with tannic acid spray, even though there might be an operator trained in the technique

With the application of tannic-acid jelly, the coagulum forms as the patient awaits medical attention and is complete in 30 to 40 minutes. No skill is required and no time has been lost, the application can be made even under unfavorable conditions and two applications should suffice This is correct first aid.

Aqueous tannic-acid jelly has

the penetrating and coagulating properties of the spray; it seals the injury rapidly, retards loss of body fluids through the burned area, excludes air and stops irritation of nerve endings, thereby allaying pain. The danger of shock is reduced as the patient awaits medical care Being water-soluble, the tannic-acid jelly or its coagulum can be removed by the surgeon without undue discomfort to the patient Tannic-acid jelly not only brings the benefit of the tannic-acid treatment for burns to the field of first aid but, likewise, co-ordinates first aid with later medical care

In summarizing, the most important message to the first-aid worker in handling burns is that he act immediately to minimize or prevent shock in the injured He can best do this in the following manner

Apply tannic-acid jelly freely over and beyond the burned area In first aid avoid the use of sprays

If the patient is conscious, administer some fluid to replace loss of body fluids Keep the burned area and the patient warm Do not use any preparation containing oils or greases Bring the patient under medical care as soon as possible

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STIMULATING

Modern Version of the "Medical Coil"

RELEGATED to many attics are "medical coils" — induction coils equipped with vibrators—that, not so many years ago, were regarded by many people as "cure-alls" The mild current supplied through handle electrodes was indeed stimulating, but certainly would not accomplish the wonders that were supposed to result

Modern medical research, however, has found that similar currents do have value in certain cases Thus, portable muscle stimulating equipment for physicians, a General Electric medical development, is a recent application of one of the oldest facts of electrical knowledge The purpose is to increase circulation, to hasten, repair, and restore function as soon as possible after enforced rest or immobilization of skeletal muscles following fracture or other injury

The apparatus, which can be adjusted by use of a vacuum-tube rectifier for either alternating- or direct-current operation, conveys to the patient through the two electrodes just enough electricity to produce a neuromuscular response at the rate of 12 contractions per minute, each simulating a natural contraction in its gradual rise to completion, with a correspondingly gradual fall to relaxation

The name of the device, a galvanic generator, recalls Luigi

The "medical coil" up-to-date

Galvani, the famous professor of anatomy at the University of Bologna, who about 1791, while preparing frog's legs for his ill wife's dinner, noticed that electricity caused their muscles to twitch and contract

FAIR EXCHANGE

Men and Women Swap Clothes To Bring Out Suspected Facts

WOMEN are two degrees cooler than men by skin temperature readings but the chief reason the sexes cannot agree about what is a comfortable indoor temperature is that women's clothes are cooler This was proved to a group of men when they donned women's filmy garments in scientific studies at the Harvard School of Public Health

The studies were reported to the American Industrial Hygiene Association by Dr C P Yaglou

"Men dressed in women's summer clothing (weighing 1 8 pounds including shoes, compared with men's summer wear of five pounds) demanded a temperature of 80 degrees Fahrenheit, which was about the same as that preferred by women (79 5 degrees) similarly dressed," Dr Yaglou reported

"Reversely, when women wore men's winter clothes (8 3 pounds instead of 2 6 pounds, the average of women's winter garb) the comfortable air temperature was just as low (70 5 degrees) as that preferred by men wearing the same clothes"

If men would wear a coatless and vestless dress with the lightest of underwear in hot summer weather, rooms would not have to be cooled below 85 degrees Fahrenheit for comfort, Dr Yaglou said The present standard is from 76 to 80 degrees With men garbed for a temperature of 85 degrees Fahrenheit in summer, there would not be the trouble now experienced from exposure to sharp temperature contrasts between apparently chilly air-conditioned buildings and the heat outdoors

In winter, Dr Yaglou said, a room temperature of about 70 degrees Fahrenheit would be comfortable for both sexes in the coldest weather, if women wore more and warmer clothes and buildings were suitably insulated —*Science Service*

POISON IVY

New Method of Protection Excludes the Poison

A VANISHING cream that gives protection against poison ivy has been developed by Dr Louis Schwartz, Dr Leon H Warren, and Frederick H Goldman of the United States Public Health Service and the National Institute of Health, Washington, D C The cream is made by correctly mixing either sodium perborate or potassium periodate with vanishing cream

Tests on nine volunteers showed that the cream protects against both poison-ivy extract, which is at least 30 times as powerful as any poison ivy leaf, and against the leaves and stems of the plant itself Two volunteers, one most susceptible and one medium susceptible to poison ivy, after rubbing on the cream, pulled out poison ivy plants by the roots, plucked the leaves, and rubbed them over their skins Neither volunteer was poisoned

The cream is made by adding 10 percent sodium perborate, or 2 percent potassium periodate, to vanishing cream The chemicals come in crystal form and should be ground to powder before mixing The vanishing cream should be made first and the chemical added The cream should be freshly prepared for use, to avoid deterioration.—*Science Service*

Interstellar Gas

More and More, Astronomers are Finding Matter as Particles Between the Stars

HENRY NORRIS RUSSELL, Ph.D.

Chairman of the Department of Astronomy and Director of the Observatory at Princeton University Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington

AN unusually interesting discovery has just been announced—namely, that molecules of chemical compounds, as well as isolated atoms, are present in the excessively rarefied gas which is found in the vast "empty" spaces between the stars The evidence, of course, comes from the spectra of distant stars whose light has traversed long paths through interstellar space

It has been known for many years that the H and K lines of calcium (absorbed by the ionized atoms of the element) are present in the spectra of many very hot stars, and are very sharp—mere hair-lines across the spectrum—while the other lines are broad and fuzzy The latter behavior is easily explained as a result of rotation of the stars, and of relatively considerable density in their atmospheres—both of which tend to widen the lines But the sharpness of the calcium lines indicates that they originate in a gas of very low density, remote from these disturbing effects A cumulative weight of evidence has convinced everyone that this gas is nowhere near the individual stars, but distributed generally—though probably more or less patchily — in space The yellow D lines of sodium were next found to appear with the same characteristics in the same stars Later the ultra-violet pair of sodium was discovered, the red line of potassium, several lines of titanium, and, in a few cases, the strongest line of neutral calcium—though very faint

It is now evident that interstellar space is by no means empty Indeed, there is probably a great deal more in it than our spectroscopes can detect

We may recall that an atom of titanium (for example) can exist in a great many different states characterized by different amounts of internal energy (definitely fixed for each one). An atom in any one of these states will absorb only a definite group of the numerous lines of the spectrum—the others coming from atoms in other states For some atoms, such as sodium, there is one "ground-state," much lower in energy than any other, so that, in the ordinary metallic vapor in the laboratory only a very small fraction of the atoms are excited into the higher states, and the absorption by the vapor shows only the "ultimate" lines coming from the ground-state For others, like titanium, there are many states with energy only a little above the bottom, and light passed through a column of vapor in an electric furnace shows absorption from a number of these states

BUT the interstellar lines of titanium are those which come from the very lowest state only The atoms in states of even a little higher energy must have some way of getting rid of it, and falling back to the lowest level From most energy levels an atom can do this by giving out an ordinary line of the familiar spectrum, and it is practically sure to do so in less than a millionth of a second, but the transitions from the lower metastable states to the bottom are "forbidden"—which means that they will happen only if the atom is left to itself without disturbance for an enormously long time—such as a second—or even several minutes in extreme cases The interstellar gas is, however, so very thin that its atoms will go weeks, or perhaps months, on the average, between collisions So they have plenty of time to settle down, and the observed situation could have been predicted.

For many of the most interesting elements, such as hydrogen, helium, carbon, nitrogen, oxygen, neon, magnesium, and silicon, the lines absorbed by atoms in the ground-state lie in the far ultra-violet, and we have no hope of observing them through the ozone in the Earth's atmosphere — which lies like a black pall upon the dreams of the astrophysicist. There does not appear to be much chance of observing interstellar lines of other elements than those already known The main reason is that the radiation of the stars tends to remove electrons from the atoms and ionize them, and the chance of picking up electrons again from those wandering about in space is poor The lines of neutral calcium are much fainter than those of ionized calcium, and Dunham calculates that there are 3500 ionized atoms for each neutral one Even for iron, which is harder to ionize, only one atom in many hundreds should be neutral

This explains why we do not find interstellar lines of aluminum and iron The neutral atoms have lines in good observable positions, but those of the ionized atoms are lost behind the ozone

In view of all this, it is surprising that a number of sharp, characteristic interstellar lines have been observed and not identified Their positions, which have been accurately measured, do not agree with the ultimate lines of any known element—and our lists of such lines from laboratory observations are undoubtedly complete (in this region of the spectrum, at least) There must be something else besides atoms in interstellar space, to absorb them

One naturally thinks of molecules but at first a great difficulty appeared The spectra absorbed (or emitted) by molecules are extremely complicated, containing thousands of lines grouped together in bands, often so closely that only the most powerful spectrographs will resolve them How can such spectra reduce to a few isolated lines such as are observed?

An answer comes by applying the principle already revealed by the atomic spectra—that all the absorbing systems (whether molecules or atoms) will be in the lowest levels of their ground-states.

Changes in the energy-state of an atom depend on changes in the configuration of the electrons in its outer regions. This can happen in a molecule, too, but so can many other things Even in a simple diatomatic molecule, the two atoms may be rotating about their center of gravity; or they may be vibrating, changing their distance on each

side of the mean value. Long series of these vibrational and rotational states are permitted by the quantum rules, and transitions between them give hosts of regularly-spaced lines. When there are only two atoms in the molecule, it is possible, with much labor, to work out just what states of oscillation and rotation correspond to each line With three or more atoms, the complications are much worse.

Now, when left to itself in interstellar space, a molecule will get rid of its energy (by radiation of forbidden lines), and settle down into a state in which the rotation and oscillation have diminished to the smallest amounts permitted by the quantum laws (which are not always zero) A molecule in this state can absorb only a very few of the host of lines which compose the familiar bands in its spectrum What is more, the residual line to which the spectrum is thus reduced will not usually be the strongest one in the completely developed band Which one of the lot it is can be found only when a detailed analysis is made, but for a number of the most important band-spectra such analyses are on record and available

UTILIZING these data, Dr Andrew McKellar, of the Dominion Astrophysical Observatory at Victoria, has shown that the interstellar line at 4300 24 agrees perfectly with the residual line of the well known hydrocarbon band, which (mixed with other lines) forms the G band in the solar spectrum Another line at 3874 61 is the sole survivor of the great cyanogen band, and one at 3934 29 can be attributed to sodium hydride

The agreement of the laboratory and interstellar wavelengths is so good in each case as to afford strong evidence, but more is forthcoming There are three more accessible bands of the CH molecule, each of which, under interstellar conditions, should reduce to a single line, at 3878 8, 3886 39, and 3890 23 In the spectrum of Zeta Ophiuchi, which shows strong interstellar lines, Adams at Mt. Wilson has found all three of these, in very close agreement with the laboratory positions, and with relative intensities as predicted His statement, "The evidence for the presence of molecules of CH in interstellar space seems to be conclusive," is none too strong in the circumstances.

Other lines of CN and NaH are also available for a test, but have not yet been looked up; but there is no reason to doubt their presence also Molecules of other kinds are presumably present, for there are sharp interstellar lines at 3957 and 4233 which are not yet classified Their identification may have to wait upon a detailed analysis of other band spectra

There are also three lines in the red, clearly of interstellar origin, but relatively broad, whose origin is still unknown

These molecules, whose presence has been detected spectroscopically, all look queer to the elementary chemist He would expect to find CH_4 (methane) instead of CH, and C_2N_2 (cyanogen gas) instead of the half-decomposed CH The spectroscopist, however, is not surprised He knows that complete, saturated molecules such as methane have their strong absorption bands far in the ultra-violet or the infra-red, out of reach of the astronomer (The methane bands observed in the outer planets correspond to weak absorption, which would not show up at all unless the quantity of the gas was enormously great in comparison to what we have been talking about) Partly dissociated molecules — chemical radicals—which are too active to remain in the free state in ordinary laboratory experiments, often show absorption in the observable region

It is highly probable that there are ordinary saturated molecules, too, in interstellar space Common hydrogen (H_2) and nitrogen (N_2) should be there if CH and CN are, and in addition there may be molecules of oxygen and other things as well.

The chemical equilibrium of such a mixture of gases, containing molecules, free atoms, ionized atoms, and free electrons, affords a complicated and intriguing problem for the theorist We have already some idea how thinly the atoms are strewn. Dunham, a year ago, calculated that in a typical interstellar region, there is one neutral sodium atom for every 20 cubic meters, and one singly ionized calcium atom for seven cubic meters The neutral calcium atoms are far less numerous—one to 25,000 cubic meters, or 160 atoms per cubic mile, as against 200,000 neutral sodium atoms. Sodium produces almost the strongest interstellar lines, and neutral calcium the weakest so far observed. The number of molecules of CH per cubic mile is probably a few thousand

To maintain even this small number of neutral calcium atoms, against the tendency of starlight to ionize them, there must be many free electrons—probably at least one per cubic centimeter, or 40 million billions per cubic mile. These must come from ionization of atoms of some sort—probably mainly from hydrogen Under the assumed conditions, hydrogen would be about 95 percent ionized, which would leave two million billion neutral hydrogen atoms per cubic mile Only an excessively small fraction of these enter into the observed hydrocarbon compounds How much carbon nitrogen, and so on there may be we do not yet know—but the amount may be roughly calculable, at least, when the problem of the dissociation of molecules under these extraordinary conditions has been solved

THE density of the interstellar gas, measured by any ordinary standards is almost inconceivably small, with one hydrogen atom (or free proton) per cubic centimeter The density comes out $1\,7 \times 10^{-24}$ that of water, or less than two ounces in a cube 2000 miles on a side Inside a space as big as Neptune's orbit, there would nevertheless be 600,000 billion tons—one ten-millionth of the Earth's mass—enough (if of suitable composition) to make a big comet or a small asteroid But inside a sphere of radius equal to the distance of Alpha Centauri, these would be $4\,7 \times 10^{32}$ grams, or almost a quarter of the Sun's mass

The total quantity of matter in this intersteller gas, on these calculations, is then a considerable fraction of that which is concentrated into the stars themselves These numbers are rough, and may be greatly altered by later and more precise calculation, but, as they stand, they do not appear very favorable to the hypothesis that the interstellar gas has been ejected from the stars—as eruptive prominences are occasionally driven off from the Sun, and hydrogen and other elements continually expelled from the Wolf-Rayet stars There seems to be too much of it to be accounted for in this way, and most of it may have been "originally" there—whatever this means.

—*Princeton, July 3*

Build No Freaks

Warships Can Be Better Designed To Meet Needs of Their Own Classes

BROCKHOLST LIVINGSTON

FOR centuries man has sought some revolutionary form of weapon which might overcome all defense He is still seeking Both on land and sea, tried forms of warfare have succeeded where novel weapons have failed—no offensive means has ever been discovered that could not be parried On the sea the ram, the monitor, the dynamite ship, and even the submarine and the airplane have appeared, but defenses against all of these have been developed

With this nation clamoring for additional defensive equipment it behooves us to move cautiously, to give calm consideration to any proposals for so-called revolutionary weapons The means we provide for our defense must be the best available but the imaginings of our feature writers should not be permitted to dictate our procurement policy

In our present quest for the most effective weapons of defense, we are examining, and properly, the possibilities of every type, from tiny motor torpedo boats to Gargantuan battleships When our studies are completed we shall probably find, as we have in the past, that tried types of weapons both on land and sea must be the backbone of our defenses

Two schools of thought exist One has unbounded belief in the efficacy of size, the other in the effectiveness of tiny craft which can dart in unseen, present the minimum possible target, and are capable of rapid production in tremendous quantities Our real defense undoubtedly lies between these two extremes

Battleships of 80,000 tons have been suggested Destroyers have trespassed into the realm of the cruiser Cruisers, long held within definite limits by naval treaties, are now proposed of a size that gives them the character of the battle cruisers of a few years back but without the strength of such ships Even submarines have been built so large that they carried armaments greater than that of existing cruisers Charles Edison, while he was Secretary of the Navy, said

Courtesy *Our Navy Magazine*

United States cruisers have come in for much criticism during recent years Note square stern

that, personally, it did not terrify him to think of a 75,000-ton ship He expressed his belief that we should provide "crushing weapons with our wealth to protect our wealth "

On the other hand, there are those who claim that one motor torpedo boat, costing in thousands what the battleships costs in millions, can protect us equally as well Given the proper opportunity, one torpedo from such a small craft can effect the same result as the guns of a many-times more costly super-ship

In considering what is best for our own defense, however, it must be borne in mind that our problems are not those of any other nation What may be proper and adequate for others is not necessarily indicative of what we should possess

The majority opinion is still in favor of the battleship, the most heavily armed and armored vessel which designers can produce Battleships must be able to protect themselves against every form of attack and, consequently, the torpedo, the mine, the shell, and the bomb are the weapons against which they gird themselves At one time they had companion battle cruisers, but England's navy, alone, now contains such vessels as a separate category While the battleship was designed to resist any blow, the battle cruiser was equal in striking power but its higher speed forced a reduction in defensive armament No ship can be designed to fulfil every requirement of sea fighting, but the battleship, with its relatively slower speed and greater defensive qualities, has heretofore approached closest to the ultimate of ship design

WHILE we were once content to give our battleships a speed of 21 knots and designed our battle cruisers for around 33, the new 45,000-ton battleships for our Navy are reported to be designed for the higher speed while mounting the same offensive armament of the 35,000 - ton class of 27 knots Battleships with speeds equal to those of cruisers will almost automatically require that the latter supporting ships be given greater speed if tactical requirements are to be met Thus we sacrifice some of the primary requirements of the battleship in order to attain the questionable advantage of higher speed

If every battleship is to be a battle cruiser, then of what is the backbone of a naval force to consist? If it is to be the 80,000-ton ship designed for the greatest possible speed, the heaviest armor, and the greatest striking power, we have arrived nowhere, for such might have been obtained within our 45,000 tons if we had been content with *adequate* speed to fulfil the mission of the type and substituted

heavier armor for weight of machinery

Our new 35,000-ton battleships carry a heavier armament than any ship in our Navy, have a higher speed and, presumably, are better protected Ten thousand additional tons on the larger ships have been used to step up speed Are we headed in the right direction? Would an 80,000-ton capital ship contain any more *legitimate* characteristics of the type than we have placed on our 35,000 tons? These are questions which must be answered

While we persistently objected to any reduction in the limitation of 10,000 tons which the naval treaties set for cruisers, we were able to provide greater offensive and defensive strength in our ships of this type than any other nation Now, with treaty limitations a thing of the past, we are talking of super-cruisers of 14,000 and even 20,000 tons While our battleships have taken on the characteristics of battle cruisers in the realm of speed, our cruisers are tending toward the battle cruiser type in offensive strength The clear-cut division between types becomes less noticeable with every new ship designed This trend indicates that the true purposes of the various types may not be very clearly defined in the minds of our directive personnel

AFTER many years of consistent belief in the need for 10,000-ton cruisers, we recently laid down four 6000-ton vessels of this type and were planning to start a series of 8000-ton craft The *Graf Spee* battle caused a halt in our plans and the decision to revert to the 10,000-ton type This decision was arrived at even in the face of the fact that one lesson to be drawn from the battle in question was the need for quantity in this type Three British cruisers of small size, light armament, but high speed, forced the heavily armed, but slower, German to its doom The *Graf Spee* was surely a hybrid if there ever was one, and a 20,000-ton cruiser for our Navy would merely repeat the mistakes of this German predecessor Such types are not for the major sea powers, they are an admission of weakness

If cruisers are tending to infringe on the domain of the capital ship, destroyers, by their ever increasing size, are stepping up toward cruiser category We have tended to copy the French and Italian navies with their special problems, and seem to forget the primary purposes of destroyers Might we not learn a lesson from one day's war news? On a single day, the Allies lost the 1870-ton British *Afridi*, the 2144-ton Polish *Grom*, and the 2436-ton French *Bison* While, in size, these vessels approached the cruiser classification, they had only the defensive strength of destroyers, and thus fell ready victims to enemy attack Our own policy toward large destroyers may perhaps be traced back to the day when we lacked cruisers and were required to use destroyers for cruiser duties They were unsuited, of course, but our new destroyers seem to have been designed to fulfil those same duties while, actually they should be designed specifically for the tasks expected of the smaller craft

Courtesy Our Navy Magazine

Too big for its class, the French destroyer *Cassard* approaches cruiser class, with a displacement of 2441 tons, seven torpedo tubes, large guns

The fleet vacancy left by the increase in size of destroyers—primarily torpedo carriers — has brought forth the motor torpedo boat This move is a clear indication of the realization that the destroyer in its legitimate role has out-grown itself Destroyers must be small enough—within sea-keeping limitations—to dash in to an attack The motor torpedo boat can fulfil this function in narrow waters and within limited ranges It does not appear suitable for a high-seas fleet such as ours, but there is an intermediate craft between the huge destroyers now building and the tiny motor boats with which we are experimenting that should meet the situation

In the last war our destroyers were vessels of 1100 to 1200 tons Now they are of 1630 and 1850 tons Due to engineering and constructional advances, it is firmly believed that the smaller ship of today could be made the equal of the larger vessels of the last war while retaining the desired characteristics of the destroyer The continuing search for a small craft to fulfill the true functions of the destroyer is evidence we have learned little about the type during the past 20 years

ONLY in the submarine classification have we shown any reason We have actually reduced the size of submarines in recent years We experimented with gigantic craft carrying 6-inch guns, but we are now building an in-between type which seems to be successful However, these ships are almost twice as large as those we were building when the last war ended Two of the latter size, on the other hand, are under construction at present—indicating that we are again inclining to the proper belief that a small submarine, in certain situations, is more suitable The airplane-carrying submarine, the submarine armed with a 12-inch gun, and other freak types which were experimented with in recent years by several nations have all been abandoned in favor of more generally useful types

Our greatest weakness in submarines is our almost complete lack of mine-laying vessels of this type We possess only one submarine mine layer and it is the largest submersible ever built for the American Navy This is a type which has been tried and found successful, and still we have neglected it It is high time we made up our deficiencies

No discussion of this nature would be complete without a reference to the anti-aircraft defense of

Courtesy "Jane's Fighting Ships"
World's largest submarine: the French *Surcouf*. Submerged displacement 4300 tons. Carries two 8-inch guns, besides a number of smaller ones plus many torpedo tubes

ships and fleets Mr Edison has stated that airplanes have a temporary advantage over ships under modern conditions of warfare Even if this be true, that advantage can be overcome by proper defense Protection must be given the gun crews on all types of ships. In this respect, we are now progressing along the right course Even our destroyers now have at least some of their guns mounted behind shields The *Wasp*, however, our latest aircraft carrier, was commissioned with her anti-aircraft guns fully exposed to attack Since attack from the air is precisely the moment when anti-aircraft weapons should be in use, greater protection must be given their crews The belief that the top-sides of battleships could be shot away and the ship still operated is no longer completely true since the elimination of anti-aircraft weapons might leave the vessel open to fatal damage from attacking aviation

While additional anti-aircraft defense in the form of protected guns must be provided on all vessels, thought should also be given to the provision of fighting planes as a part of the aviation complements of the larger ships Ships operating alone or in small detachments must be provided with their own means of defense against aerial attack

We are now contemplating the conversion of old destroyers into special anti-aircraft vessels (the British have had them for some time). Any such addition to a fleet's ability to defend itself against attack from the air must be encouraged, but reliance upon special vessels for such protection might find the necessary craft in the wrong positions and leave a fleet open to serious damage The aircraft defense of ships had best be concentrated on the ships themselves

Even considering these critical remarks, we may rest content that our ships, generally, are today the equals, if not superiors, of similar ships in any navy Our desire should be to keep them to their present high standard Adequate defense cannot be obtained by the adoption of freak types A well-rounded defense consisting of tried types is our salvation We cannot expect to build the ship in which the characteristics of every type is embodied We must revert to a policy of clear-cut divisions between types, giving each the maximum striking and defensive strength suitable to it We must limit each ship to reasonable size in order to avoid too great a loss to the whole when any one is destroyed In short, we must continue the beliefs of earlier days and avoid, by all means, any tendency toward freakish types, for they have been found wanting in the past and have always been a sign of a weaker naval power We cannot afford to be considered that.

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U. S. TANKS

New Armored Corps Modelled After Those of Germany

READERS learned from Captain McInerney's article in the August Scientific American that the tank set-up of the American Army differed greatly from that of the destructively successful German Panzer Divisionen. Since publication of that article, the War Department has announced adoption of tank tactics similar to those of the Germans and the creation of an armored corps of two divisions on an experimental basis All tanks and other vehicles formally assigned to the infantry and cavalry will be concentrated in the new corps which will consist of more than 18,000 officers and men The corps will be equipped with 1400 tanks, 600 artillery pieces, and more than 13,000 automatic and semi-automatic rifles, according to reports This new unit is made possible by a recent appropriation which included provisions for procurement of 3000 tanks for the army Only about 500 are available at present

This new, fully mechanized corps will be capable of striking at speeds of 50 miles per hour It will probably be equipped mainly, according to official comment, with a number of heavy units about twice the weight of present medium tanks Our Army does not use the 70 or 80-ton monsters such as those in the German and French Armies, and at present there is no suggestion that such tanks might be built by the United States

"NORTH CAROLINA"

THE photograph below shows the launching of the *North Carolina*, the second of two battleships launched this year, the two marking the first expansion in our battleship force since 1920 The *North Carolina* will be of 35,000 tons displacement and will carry nine 16-inch guns, twelve 5-inch, 51 caliber guns, and eight 5-inch anti-aircraft guns, and four airplanes and two catapults She will be approximately 35 percent welded instead of riveted, thus saving weight which can be utilized in other ways. Her cost will be an estimated $65,000,000.

Courtesy *Our Navy Magazine*
Launching the *North Carolina*, second of two launched in 1940

"ALL-AMERICAN" WAR

PROPAGANDA is a wondrous thing It has made of Hitler, according to the welcoming phrases of German newspapers when he recently returned from the Battle of France· "A Genius for Commanding," "The Lord of Battle," "Leader from Darkness to Light." It has made of him a legendary hero of the proportions of a Napoleon and a Caesar rolled into one

It will, however, help the logical processes of American thinking in developing our national defense if we remember that Hitler is but a man. Hitler does not direct the tactics of the German Army Men trained in the science of war do the commanding It is even doubted in some quarters whether it is his decision which unleashes the might of the Nazi columns according to the plans worked out by his military chieftains Theirs is the knowledge of war, theirs must also be the knowledge of precise timing

But he has brought to war so many new weapons and methods? Has he? Definitely not The blitzkrieg is about as old as war, but Sherman's march to the sea is sufficient as an example Only the speed is new Tanks in large numbers? Hannibal had his herds of fighting, warrior-carrying elephants And the tank is but a British adaptation of the commercial tractor developed by Americans Airplanes are, of course, from an American invention Dive-bombing is wholly American Parachute troops? One radio commentator, whose authority we can trust, claims priority for the American Army in that tactic — even over the much-publicized Russian parachute experiments But, we hear, the Germans are geniuses for industrial efficiency Are they? They have but followed American technique for industrial planning and organization — a technique in which we lead the world Indeed, mass production, as a system, was invented by an American Eli Whitney, of cotton gin fame

"Plan" is the whole secret of German success in war — plan, organization, co-ordination And don't forget starvation — the tightened belts that made possible their tools of war. Hitler is not the secret He is only the figurehead, the angel with wings of propaganda and feet of clay It is German planning and doing and sacrificing that the world must beat So far as American national defense is concerned, we *can* beat it hands down — and a dozen times over Are we going to do it, or sit back, play politics, and say "What's the use? Hitler is invincible"?—*F D. M.*

HOT OR COLD

WILL hot water freeze faster than cold water? An excerpt from *Science*, printed on the "Browsing With The Editor" page in our August issue, says "No" This answer to an age-old question promises to stir up one of those minor controversies that make interesting speculation.

Offhand, logic would plainly indicate that cold water should freeze faster than hot; both must be cooled to zero, centigrade, and logic dictates that the temperature differential is such that cold water will reach this point long before hot water. But may not this be one of those occasions in which logic is so plain as to lead the logician astray?

Such may be the case. Conflicting experimental evidence has been produced to answer the question both ways: hot water freezes first; cold water freezes first

Plumbers tells us that the pipes carrying hot water in homes will burst (but not necessarily freeze) before the cold water pipes, when exposed to low temperatures over long periods of time But it has been rather definitely settled that this phenomenon involves the question of differences in quantity of dissolved air in the two systems

What are the facts when the hot and the cold water are subjected to low temperatures under identical and controlled conditions? The family refrigerator, mixtures of ice and salt, the cold-storage box of the neighborhood butcher — all offer experimental possibilities

No world-shaking revelations are promised by the answer to the question, but the editor will entertain the thought of publishing submitted results of controlled experiments made by readers. Here is a question that should be answered once and for all, if for no other reason than to prove or disprove the soundness of logic applied to a simple problem —*A P P*

LIGHT

"PEOPLE'S eyes never were intended to stand the more and more powerful illumination they are using today."

"You've complained of tired eyes, yet now you install a big 100-watt lamp only 18 inches or so above your desk to tire them faster It isn't intelligent "

The desk really did seem pretty bright with the new lamp in its deep reflector, and it kept on worrying office callers "Why, that's brighter than the sun," they said.

One day in May, when the sun crept high enough in the sky to shoot a brief noonday pencil of light down through one of New York's canyons and directly on the desk, overlapping part of the lamp's illumination with a sharp demarcated area of its own, the facts came vividly and literally to light The lamp-lighted area, considered too bright by callers, now seemed only dusky by comparison It looked like deep shadow.

The sun's light approaches 10,000 foot-candles but take 5000 as something like the natural outdoor level under which human eyes evolved For regular reading, it is, however, pretty strong

The science of seeing, according to its ablest authority, Dr M Luckiesh, Director of General Electric's Lighting Research Laboratory, reveals evidence that you could read this printed page easiest at 100 to 1000 foot-candles. As a temporary compromise it recommends at least 50 to 100 for difficult reading and 20 to 50 for ordinary reading

It's easy to underdo working illumination — hard to overdo it. On lighting, the world is steadily learning a new set of values — higher Ultimately, they'll go much higher, in accord with good science —*A G. I.*

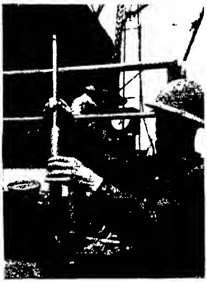
Mud, Concrete, and Oil

Drilling Mud, Treated Like a Favorite Child, Makes Possible Wells Miles Deep

ANDREW R. BOONE

In the summer of 1858, Col Edward L Drake, a former railroad conductor willing to gamble on a strange new venture, started the first test bit into the earth at Titusville, Pennsylvania He drove down a 36-foot casing and, using a wheezy six-horsepower engine, drilled inside the pipe At a depth of 69½ feet, the Colonel discovered oil for the first time in history, and shortly thereafter sold his output at 60 cents a gallon

Across the continent in sun-baked San Joaquin valley, near Wasco, California, a diminutive



Checking specific gravity of mud returned from circulation

tool pusher named Louie Hopkins recently completed, for the Continental Oil Co , his ninth hole deeper than 13,000 feet One of the wells drilled by Hopkins, the KCL-A2, hit bottom at the world's record depth of 15,004 feet, 215 times deeper than Drake's discovery Whereas Drake's "Folly," as envious diehards dubbed the first exploration 82 years ago, barely pricked the earth's surface, in nine tries Hopkins has directed the bit downward a total of some 22 miles From his deepest well oil is flowing upward more than 2½ miles Instead of 60 cents a gallon, this oil, brought in at a cost of $300,000, fetches on the current market less than the small sum of three cents a gallon

Diamond-tough drilling steels, borers ranging from bomb-like structures to rock smashers consisting of cones which rotate within revolving bits, new and more powerful steam engines capable of shoving mud down inside the drill pipe and thousands of feet upward again, basket-like cement plugs and pipe whose threads will not pull apart under the tremendous weight of 500 tons, make it possible to reach deep sands and bring their loads of black gold into production

Mud testers and cement mixers make possible fast drilling and completion of wells uncontaminated by water and sand On every deep-test rig you'll find a mud engineer on the job constantly Drilling mud is a mixture of water and some powdery non-metallic mineral, such as gypsum, often fortified by several chemicals, including chestnut extract and quebrach It is pumped down inside the drill pipe, out through the bit and up between the pipe and the walls of the hole It must keep moving, carrying up cuttings, lubricating the pipe, and preventing cave-ins, otherwise the drill pipe will stick and the hole be lost

Hopkins knows mud and treats it like a favorite child, for this sticky substance has given him an enviable record He starts it down weighing exactly 95 pounds per cubic foot After it has mushed through deep shale hot enough to boil water and has picked up a load of gas, he runs it through a series of paddles operating in vacuum, and returns it to a nearby pit to await the next trip down The agitator removes the gas and reconditions the mud

When at last the bit penetrates oil sand, cement men drive up with their mixers and prepare to wall off any water which may leak down

Expanding brass baskets keep concrete from below the casing

When concreting a deep oil well, men must work at top speed. The mix must reach bottom and return outside the casing before it begins to set

The wooden blocks that are used when concreting a well

from upper formations Two plugs and an expanding basket make possible effective shut - offs The basket is lowered to the bottom, and expands when concrete begins to press against its insides This prevents the mix from moving down into the oil formation A wooden block containing a hole through which the concrete may escape slides down the casing, following the basket to bottom After the block goes a column of concrete, followed by an upper block which separates the concrete and the mud which powerful pumps force down against the upper block

Not long ago a cement crew slashed open 1400 sacks and forced the mix downward, cementing a California well 11,000 feet deep in 30 minutes, 30 seconds That was one record "Shucks," commented the foreman of another crew next day, "we placed 2000 sacks in 24 minutes, 40 seconds" What he meant was, 50 workmen had prepared the mix, and two batteries of pumps had forced the gray slush down more than two miles and up 4200 feet between the casing and rocky walls of the hole in that time. Meanwhile, to prevent a jam, the cables had been picking up and lowering 425,700 pounds of drill pipe in 15-foot steps, as easily as you lift a kitchen chair.

Wells four miles deep are a definite possibility during the next few years May they go on down farther to unexplored horizons, tapping little-known sediments that were laid down in remote geologic ages?

Colonel Drake little dreamed that his 25-barrel production would multiply by millions He batted 1000 by bringing in a wildcat when friends and relatives hooted at his wild dreams Louie Hopkins batted 666 on his nine deepest wells, but the six flowing today came in with 440 times more oil than the colonel found Louie is ready to try his luck with a four-mile hole All he wants is a good head of steam, enough pipe to reach bottom and a mixture of mud and chemicals which he knows from experience will keep the rig turning until he gets there

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Under Mobile River

Vehicular Tunnel Built On Land, Floated Into Place, Shows Engineering Advances

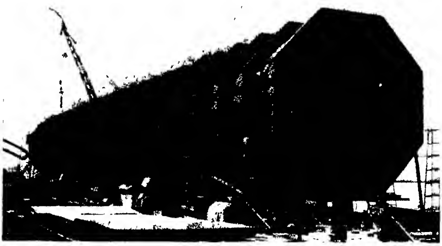
R. G. SKERRETT

MOBILE, Alabama, on the much traveled old Spanish Trail, has built, at a cost of $4,000,000, a different type of subaqueous tunnel for the convenience of automotive traffic The tunnel will shorten the east and west route by 7½ miles, and will materially reduce heavy traffic congestion

Mobile is at the mouth of Mobile River and at the head of Mobile Bay at a point 30 miles inland and north of the Gulf of Mexico The city is Alabama's historic and only seaport It is on the west bank of the stream, opposite Blakely Island

Work on the Bankhead Tunnel, as the river underpass is called, was started in July of last year It links Mobile with Blakely Island and connects with a 10½-mile causeway extending eastward from the island and spanning several narrow water gaps

The under-water sections of the tunnel were built at a local shipyard, launched one by one, towed to a nearby slip on the west side of Blakely Island, and there brought to a stage of near completion before being moved to and sunk in a deep trench dug in the river bed Five of the seven sections are each 298 feet long, and the two other sections are each 225 feet long The under-river structure has a total length of 2000 feet, and near each shoreward end there is a transition section which connects with a rectangular or box-like section of the tunnel At the Mobile end, an open ramp approach extends downward from the street level to the portal of the western section On Blakely Island, the steel box section runs right up to



Partly finished steel framework of an under-river section. Steel plating covered the outer octagonal ribs, and concrete filled the space thus made

The top of the outer shell of this tube at Blakeley Island is open so that workmen may install wiring conduits, pour the concrete, and so forth

the ground surface, and is equipped with a steel gate which may be closed, in time of hurricanes, against water piled up on the island The Bankhead tunnel has a total length of nearly 3390 feet between grade levels, and its roadway is 21 feet wide for two traffic lanes — eastbound and westbound

The Bankhead Tunnel is similar in principle to the Detroit Tunnel, built in 1930, but differs in a number of particulars which represent engineering advances Each tubular section of the under-river divisions is made up of an inner steel cylinder 30 feet in diameter surrounded by an octagonal steel tube that has a minimum diameter of 34 feet The two concentric tubes were tied together by equidistant radial ribs, and the spaces between the two tubes filled with concrete before being finally sunk in the trench and covered The inner tube of each section is lined with reinforced concrete not less than 18 inches thick The top of the tunnel, in mid-channel, is about 46 feet below the level of mean low water

Each end of each tube was sealed temporarily with a watertight steel bulkhead before launching, and concrete was poured into the inter-tubular space to a height of 10 feet to give each section stability when it was first launched Steelwork was put together by welding, and, before launching, each tube was coated with soapy water and subjected to internal air pressure—any leak promptly blew tell-tale bubbles

At Blakely Island, openings were cut in the top plates of each inner tube to give temporary access to the inside of a section so workmen could place the concrete lining, the conduits for power, lighting, and telephone circuits, the roadway slabs and the ventilating duct beneath the mid-section roadway for a distance of 400 feet That done, the access hatchways were sealed, and the sections, starting at Blakely Island, were floated to the trench and sunk

At the trench, the last of the concrete was poured into the spaces between the inner and outer shells until a section lost its buoyancy It was held suspended in a sling and lowered deliberately Succeeding sections were brought together by pulling the newly laid section, with ratchet turnbuckles, snugly against one already installed A projecting ring on one fitted into an annular recess filled with a rubberized gasket on the other Divers did this work Later, the joint was covered on the outside with concrete poured underwater Finally, when bulkheads were cut away, adjacent inner tubes were tied together by a welded ring of steel

One ventilation building, on Blakely Island, is equipped with exhaust fans only which suck vitiated air into ports on both sides of the roadway level for 400 feet in the mid-section of the river part No fresh air is blown into the tunnel, but the action of the fans at the low point is counted upon to draw fresh air inward and downward from both portals and maintain proper circulation. This arrangement is based upon experimental work of the U. S. Bureau of Mines An unusual feature of the illumination is that, while lights are arranged to give proper illumination at all points in the tunnel, special additional lights are installed near each portal These latter lights burn only during the day, their purpose being to make the transition more gradual for the eyes of the driver as he enters from the strong outside sunlight.

ROAD PROTECTION

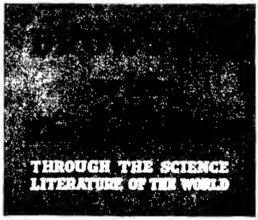
Bags of Green Concrete Laid as Rip-rap

ONE of the most troublesome problems of road building and maintenance is that of protecting slopes against erosion. Where run-off is rapid and in large volume, it is practically impossible to start sufficient plant growth to root the soil in place In such cases, engineers often resort to use of rock rip-rap In California, on some sections of highway, engineers are making their "stones" and, in addition, are making them so that they dovetail

Because of bad wash-outs along highway slopes, and particularly where the water action is of such tremendous power that boulders five to eight feet in diameter are carried away, the slopes are being lined with bags of concrete. As an accompanying picture shows, these bags are filled with green concrete and then laid on the embankment in even, horizontal rows In their damp state, the filled bags press down, one layer upon the other, so that when they harden, they fit into and hold each other tightly The finished slope presents a pleasing appearance that could never be attained by use of rough stones

Engineers are watching the results with this form of slope protection, for it is believed that it will be superior to ordinary rip-rap

Man-made "stones" protect road



IDAHO WHITE PINE SUPPLY—White pine is being drained from the famous Idaho forest lands two and a quarter times faster than Nature restores it By replanting now, stopping fires, and cutting timber scientifically, we can make restoration balance use in five decades.—"Forest Increment in North Idaho," U. S Forest Survey Release No. 18

HIT BY CARS—In one group of pedestrian fatalities caused by automobiles in Wisconsin, 81 percent of the victims were unfamiliar with the operation of the vehicle which caused their deaths Doubtless this condition is general, for Connecticut reports 94 percent of pedestrian fatalities were people not licensed to drive—*Highway Research Abstracts*, July, 1940

PLANES BY THE POUND—The thousands of warplanes Uncle Sam is ordering for defense will cost about $7 50 a pound The announced goal of 50,000 a year means the production of over half a billion pounds of airplanes, engines, and propellers—*Science Parade*, July 13, 1940

LIGHT AND ACCIDENTS—The National Safety Council estimates that 5 percent of industrial accidents—in other words, $75,000,000 worth—are caused by poor light—*Industrial Bulletin* of Arthur D Little, Inc, Number 153

RENTED AIR CONDITIONING—An air conditioning system that can be rented by the day or evening, along with the auditorium it serves, has been installed in the Jewish Community Center in Detroit Ice is used to provide cooling during periodic uses of the system.—*Refrigeration and Air Conditioning*, June, 1940

FURNACE RECORD—A blast furnace of the Otis Steel Company has probably achieved the record of operating for the longest period of uninterrupted use ever obtained on a single blast furnace lining From May 1930 to May 1940 it operated continuously without being blown out, producing in that 10 years 1,735,500 gross tons—Hill & Knowlton notes, May 17, 1940

STRAIGHT ROAD—An Italian "autostrad" across North Africa has one stretch 400 miles long without a sharp turn.—W C Lowdermilk, *American Forests*, July, 1940

SHIP UNLOADING—Ships that unload themselves with the aid of belt conveyors, which have been in use for more than 20 years on the Great Lakes, are beginning to win acceptance on the Atlantic Coast, where the second ocean-going vessel thus equipped has recently been put into service—*Oil-Power*, July, 1940

FOREST FIRES—It is not improbable that, in the daylight hours, an average of one forest fire is set every two minutes in the United States—probably every minute during the vacation months This is an indictment of people who are careless in the use of tobacco, because that is the cause of most of our forest fires—*News*, New York State College of Forestry.

LOCOMOTIVES—The American railroads have 46,544 locomotives, of which number 45,210 are operated by steam, 882 by electricity and 452 by gasoline or oil—Association of American Railroads.

CONSERVATION FOR DEFENSE—Conservation today takes on new importance because of the urgency of national defense. A country's natural resources sustain its defensive and combatant power. This is true of forests no less than oil and other natural resources.—*American Forests*, July, 1940

ARTIFICIAL RUBBER COST.—The cheapest commercial "synthetic" rubber today costs about twice as much as the natural product—Lawrence A Wood, Ph D, Circular C427, National Bureau of Standards

SILICOSIS—During 1939, 91 miners were certified to have died of silicosis and 355 certified to have been disabled by the disease in the South Wales coalfield—*Nature* (London), June 22, 1940

AIRPORT PAVING—The new Washington, D C, airport will have a total asphalted area, including four huge runways, parking areas, and roads, equivalent to 83 miles of highway 18 feet wide What is purported to be the world's largest airport, in Newfoundland, has the equivalent of 116 miles of 18-foot asphalted paving—*American Petroleum Institute*, July 7, 1940

ON THE 'PHONE—Americans, person for person, telephone 14 times more often than the rest of the world Furthermore, this country has about half the world's telephones, and makes something like 1000 calls a second—*Telephone News Bulletin*, May, 1940

INDUSTRIAL ALCOHOL—Approximately 198,467,000 pounds of corn and 202,631,000 gallons of molasses are annually manufactured into industrial alcohol—*Monsanto Magazine*, May, 1940.

SHOCKING EELS—An electric eel may discharge as much as 1000 watts of electricity at a voltage of 600 This discharge is at the frequency of 200 or 300 times a second—*The Lamp* (Standard Oil Company of New Jersey), April 1940

MORE SOYBEANS—Soybean production in the United States has multiplied 22 times in the past 15 years, 17 times in the past six years—*American Chemical Society*.

BULLS SEE NO RED—The popular idea that bulls fight when they see red has long been exploded The bulls are color-blind It is the movement, not the color, that infuriates—*Science Parade*, May 6, 1940

EXPLOSIVES BY RAIL—Railroads of the United States and Canada in the past 13 years have transported billions of pounds of high explosives, including dynamite, black and smokeless powder and explosive ammunition, without accident, death, or injury—Association of American Railroads

STOP AND GO—A mere 15 years ago, a green light on Fifth Avenue, New York City, meant "stop," yellow meant "go," and red meant "caution"—*Science Parade*, May 4, 1940

AUTOMOBILE EXHAUSTS.—Gasoline burning in automobiles produces enough carbon dioxide in a year to make 160,000,000 tons of "dry ice"—*The Lamp* (Standard Oil Company of New Jersey), April 1940.

Helicopters

Rotating-Wing Aircraft Exhibit Desirable Characteristics for National Defense

ALEXANDER KLEMIN
Aviation Editor, Scientific American. In charge Daniel Guggenheim School of Aeronautics, New York University

THE writer of these notes has been criticized for allowing the school of aeronautics with which he is associated to give real attention to rotating-wing aircraft at a time when the airplane is so important as a means of national defense! But is it not possible that rotary-wing aircraft—autogiro or helicopter—will also serve most usefully in national defense? At least a wise and experienced engineer—Igor Sikorsky—is of this opinion, and voiced his views strongly and persuasively at a recent meeting of the Society of Automotive Engineers

The airplane, by the nature of its design, will always be faster than the helicopter—say 500 miles an hour against a potential 300 miles an hour for the rotating-wing craft However, for defensive military purposes the helicopter can perform in a number of ways which are impossible for the airplane Let us quote Mr Sikorsky

"For example, to interpose an effective defense against bombers or dive bombers, the helicopter seems to me to be ideal It can stand still in the air, thus affording a stable gun emplacement from which the gunner can await the moment—which must come either in altitude bombing or dive bombing—when the bomber ceases all zig-zag maneuvering and flies a straight line for its quarry Then the bomber is comparatively easy to hit The helicopter, of course, can easily have altitude performance up to 15,000 feet or more and can carry large-caliber machine guns or even cannon "

The helicopter can also remain poised above strategic spots It can evacuate the wounded, particularly at night By descending within reach of the ground to pick up man and litter, the helicopter can act as a perfect air ambulance Again, said Mr Sikorsky, "once launched from a battleship or cruiser the airplane can be recovered only by alighting on the sea, if it is smooth enough, while the craft is lifted aboard Obviously, in battle, major units cannot stop to pick up aircraft even if conditions of wind and water make this possible The helicopter however, would require only a platform or deck space of about 40 feet square from which to take off and on which to land It could follow every dodging movement of the surface craft, flying backwards, sideways or forward at will and always itself afford a steady firing point for its defensive guns "

Landing gear for the helicopter would be rubber bags rather than wheels and on these bags the machine could use land, water, ice, snow, a vessel, or a building for a take-off or landing Pilots could be trained to fly a helicopter with relative ease

Mr Sikorsky has made a logical and strong plea which should not be forgotten

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AIRSHIPS

Still Hold Possibilities for Military Purposes

GENERAL opinion, public and aeronautical, is that the airship is dead, that it is too slow and vulnerable for fighting purposes, too slow for transoceanic passenger work when the Clippers can fly three times as fast The Navy Department does not agree with this view A special board on the lighter-than-air situation reports to the effect that in spite of all disasters and speed inferiority, relatively small rigid airships should be built

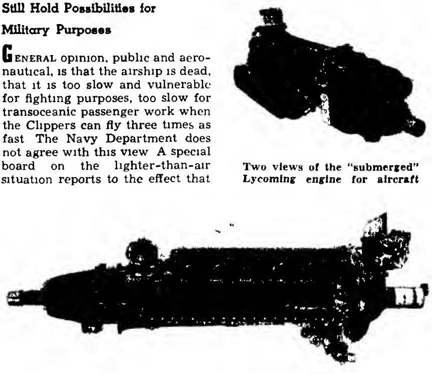
With its ability to carry airplanes, the rigid airship can be best compared with a cruiser or an airplane carrier The cruiser is capable of about 30 knots sustained speed for three days, the modern airship can deliver 60 knots for six days The airship can be conceived as an airplane-carrier immune to mines, torpedoes, and submarines, which could well proceed overseas and, lying well off an enemy coast, launch a successful airplane attack The airship would be most useful in long range observation, scouting, reconnaissance

Of course, we could cite many arguments against further airship effort But to build a small dirigible of 3,000,000 cubic-feet capacity, at a cost of $3,500,000 for training of personnel and experimental purposes is an idea worth considering —*A K*

ENGINE

"Submerged" Design Increases Flying Efficiency

AS the drag of landing gear, external supports, and even of the fuselage is reduced, and the airplane approaches the ideal of the "flying wing," it becomes more and more important to eliminate the drag of exposed engine nacelles



Two views of the "submerged" Lycoming engine for aircraft

Designers advocate the "submerged" engine—that is, an engine which is enclosed completely within the wing—and argue that the hidden engine will decrease fuel consumption and increase speed Now, the Lycoming engine division of Aviation Manufacturing Corporation has produced a novel "flat" engine which should meet with immediate application in our military and naval aircraft

The Lycoming flat engine is illustrated in two of our photographs There are 12 cylinders, six on each side of the crankshaft The over-all height is only 37 inches compared with the 49- to 54-inch diameter of the conventional radial air-cooled engine The low frontal area and low height makes it perfectly feasible to house the engine completely within the wing Of course, the problem of airplane balance has to be met, since the weight of the radial engine is located quite far forward, relative to the rest of the airplane, but designers will meet the situation Also, the flat engine, being liquid cooled, has to have a radiator But the radiator can be filled with Prestone which operates at a much higher temperature than water, and hence the radiator can be quite small Further, the radiator can be ducted or streamlined partially in the under side of the wing

Altogether this is a praiseworthy and promising development, which comes at the right time in the national defense emergency —*A K*

RIVETS

Salvaging Methods Cut Costs in Airplane Assembly

PRODUCTION engineers of the Glenn L Martin Aircraft Company long ago discovered that it was cheaper to let lie the rivets dropped accidentally on the airplane assembly floor than to have operators take time out to pick them up The riveter's time is valuable, a skilled worker is expected to drive 1000 rivets a day Nevertheless, dropped

Side view of the Ercoupe, practically spin-proof

rivets represented a real problem, since a pound of aluminum rivets costs approximately one dollar, and some 60 pounds of the rivets were swept up every day A team of boys used to sort out the rivets by hand, but it was slow and uneconomical work to separate the round-head and flat-headed rivets and those of varying lengths and diameters

Now the tool designers have developed a rapid, semi-automatic process An electro-magnet is passed over the floor sweepings, snatching up extraneous steel and iron material The residue is chiefly rivets of some 150 different kinds Next, a series of sifters sort out the rivets for diameter in much the same way as gravel is graded Then a mechanical device separates the rivets for length, the rivets travel around the perimeter of a wheel until they are knocked off by the length gages To expedite

Steps in salvaging rivets. Lower left: Sorting for diameter with sifter. Above: Sorting for length. Below. Separating round-heads from flat-heads

the process further, a little hand-operated machine has been developed which serves to separate round-heads from flat-heads The round heads drop out first, the flat heads next.

Obviously, our tool designers will play a not insignificant part in the national defense effort

UNCONVENTIONAL

Combined Features Make Spin-Proof Airplane

WE have for several years been of the opinion that all the aerodynamic factors required to give us a spin-proof airplane were already available A new, somewhat unconventional airplane, the Ercoupe, seems to come near to this safety requirement At least no inspector of the Civil Aeronautics Authority has been able to spin the new machine

While the wing of the Ercoupe is thick throughout, and is externally unbraced, it is rectangular in plan form — there is no taper With a sharply tapered wing, the tips stall first With a rectangular wing it is the center section which stalls first Moreover, the leading edge of the center section is brought down to a sharp V, and this again tends to make the center stall first With the center stalling first, there is no tendency to fall off on one wing — an initial step in the spin Again, the two rudders are quite clear of the fuselage, being carried at the ends of the horizontal tail surface Therefore, at high angles of attack, with the nose pulled up sharply, the vertical surfaces are not blanketed in any way, and retain their full effectiveness

But there is still another factor which is a spin safeguard for the novice pilot The upward travel of the elevator, which of course tends to raise the nose of the aircraft, is strictly limited Thus the novice cannot readily put the machine in a stalled attitude —*A. K.*

No Short-Cut Horticulture

Plant Growth Chemicals Require Pains-taking Care, Promise Significant Results

PHILIP H. SMITH

THERE is a widespread impression that chemistry is leading horticulture and agriculture into a new era, marked by the abolition of the hoe, the wheelbarrow, and the spraygun. Given a pill or a powder and the novice will become an expert overnight, flowers and vegetables will increase from half-dollar to dinner plate size, and meals will be plucked from fire-escapes. But why go on?—your imagination is as good as mine.

Plant chemicals can accomplish wonders. Some make possible plant growth in water solutions, quite remote from soil, some will stimulate root growth on cuttings, others will make fruit form without pollination. There is one chemical which induces root growth on backward plants, and another which enables the hybridizer to create new varieties which nature might never get around to do.

In reporting these wonders, scientists have given fact, not fancy, and no further confirmation is needed. All fact can be visually substantiated in this or that laboratory. But the layman asks the significance of all this to him. "Can I," he says, "get results with the chemicals? Is water culture commercially feasible? Can grandma's begonia be reproduced by a tyro?"

At the risk of posing as an old meany, I must declare that horticulture is about where it was before the advent of these chemicals, except that there are probably more bugs in the world. But the use of chemicals introduces something new, promising, and anchored in scientific fact. It offers means to experimentation and acquisition of knowledge about plants, it promises little ease and less profit.

Gardening without soil, variously called tank culture, tray-farming, and hydroponics, has developed fast and in a number of directions. There is now great variety in form and composition of tanks, in the constituents of the nutrient, and in the method of feeding. Experimenters seem to favor the system known as gravel and cinder culture. Here, the plants actually grow in gravel or cinders and are fed periodically by sub-irrigation.

Successful tank culture calls for sunlight and air. These elements are quite as essential to growth as in soil culture. Thus an immediate

Science Service photograph

Colchicine doubled the chromosomes in this peach tree at Beltsville, Maryland

requirement is outdoor or greenhouse location, and whatever the solution fed, it must be properly aerated. Temperature, too, is important and for best results there must be a carefully controlled differential between air and solution temperatures and between day and night temperatures. Once the general procedure has been determined, there remain such technical problems as: character of water used, acidity of the solution, proper replenishment of salts in the nutrient to replace unequal consumption by the plants and losses by precipitation, toxic effect of tanks and beds, and the precise timing of every operation.

Gravel and cinder culture is recommended as having these advantages: elimination of cultivation, watering, weeding, fertilizing, soil changes, and many soil-borne diseases, control of the type of growth, and virtually automatic operation. However, these advantages must be weighed against the cares outlined in the foregoing paragraph to determine the net gain, even assuming profitable operation. Some people prefer scratching the soil to reading thermometers, minding valves, or keeping accurate records.

The number of persons operating commercially successful hydroponic farms can be counted on your fingers, although the number will doubtless increase. It is a highly exacting and specialized performance and at this stage its costs are such as to limit its practical possibilities to areas where out-of-season crops demand premium prices, where there is lack of good soil, or where the soil is so poor that it takes heavy outlay to keep it at par. Certain geographical sections are unsuited to hydroponics because in off-season, when crops are wanted, the sunlight is inadequate.

DEVOTEES of hydroponics declare that tomatoes have been raised successfully in water solution and the fruit is of superior quality. This is true. But it has not been proved definitely that the same care and control applied to soil culture would not produce a comparable crop. The successful hydroponitian is a man who has acquired an intimate knowledge of the plant he grows—its habits and climatic needs, its mode of propagation, and the control of pests and diseases—usually from previous soil culture.

The uninitiated believe the critical factor in hydroponics to be the chemical formula, but this is secondary to the facts just mentioned. The problem of what to feed has been pretty well solved and formulated chemicals can be bought in the market. Of the several formulas in use, there is little variation. A good all-around composition calls for potassium

phosphate (monobasic), potassium nitrate, calcium nitrate, and magnesium sulfate, to which is added minute amounts of iron, boron, manganese, zinc, and copper. Waters differ greatly as between geographic areas, hence the experimenter must modify basic solutions to obtain proper salt content if he would obtain good results

Far more interesting than the water-solution chemicals are the hormone-like substances which modify or regulate plant growth These chemicals are called "hormone-like" because they are substances thought to act like unknown plant hormones They are not laboratory syntheses as is widely believed As a matter of fact, those which induce root growth have never been found in plant life There are some 50 of them known to scientists as being capable of playing tricks on plants, but there are only three in common use today These are naphthalenaacetic, indoleacetic, and indolebutyric acids Of these, the last named has proved most satisfactory because it is effective over a wider range of concentrations

THE root-inducing power of these chemicals is unquestionable If they are applied to leaves or flower stalks, for example, roots will grow from the places touched The immediate, practical value of these substances is in the propagation of plants and shrubs from cuttings, either to hasten the process of root formation or to make roots grow on cuttings of species ordinarily non-rooting Common practice is to dip the basal end of cutting in a solution of indolebutyric acid for 24 hours, or to dust with a powder composed of hormone and talc; otherwise propagation technique remains unchanged

It would be a serious mistake to assume that these substances are infallible because they have had certain unparalleled success Combined with the capacity to induce roots, is a like power to retard growth and inhibit bud formation Sometime the technique may be worked out to take advantage of these added powers, but at present they impose care lest too strong a concentration kill the entire cutting. Root inducers do not eliminate the seasonal factor in propagation, nor will all species respond to their coaxing. Every variety of plant or shrub has its own peculiarities which must be given consideration. In general, leafy cuttings respond much better than hardwood cuttings, whatever the species

The hormone-like substances can do more than induce root growth Artificial stimulation of fruit—that is, the formation of fruit without pollination—is one of the achievements. The classic example is the manufacture of red berries on the American holly When the male tree is too far from the female tree to permit transfer of pollen, no berries are formed from the female flower Here

Courtesy *Industrial and Engineering Chemistry*

One way of drugging a plant: treating seeds with colchicine

naphthaleneacetic acid comes to the rescue Spraying the flowers with a solution of the acid will cause berries to be formed They will be seedless, but who cares at Christmas The practical value of this treatment is another story. The acid costs more per ounce than gold, and the most economical solution to the production of red berries would seem to be to plant more male bushes However, this type of experiment hints at the future production of seedless fruits and vegetables—seedless tomatoes, for example, for persons allergic to tomato seeds

Experimenters report success in the use of these chemicals for restoring the viability of seed This would be a boon to seedsmen, not to mention the backyard gardener who invariably ends the season with a surplus of packaged seeds and hesitates to use them the following year lest it spell crop failure. Other claims for these hormone-like substances are: acceleration of seed germination, increase of crop yield, inhibiting of fungi growth, particularly of the damping-off variety, increase of

Science Service photograph

Simpler than soaking: painting slit twig-tip with colchicine

callus formation in grafting, the speeding up of bulb development, and the building of better lawn turf However, no use of chemicals has reached the "simply add hot water and serve" stage, and until the amateur can maintain a cheerful attitude in the face of failure, he would do well to await more conclusive proof of these last mentioned wonders

Seed catalog fans have been given a genuine thrill this year by the announcement of a chemically-produced variety of marigold This is the first commercial offering arriving from the use of the powerful drug colchicine

THE discovery that colchicine can retard cell division and multiply the number of chromosomes in a plant has occasioned wide speculation Are we about to see the family-sized vegetable? Is the genius of the laboratory about to produce a Frankenstein monster? Well, there are limits to what colchicine will do If breeding experiments begin with a squash, they end with one, although the new squash may be bigger and have qualities assembled to the breeder's taste

Colchicine does put a very valuable tool in the hands of hybridizers and the result will most certainly be a quickening of new variety origination What the drug really does is accelerate the natural process of breeding, to accomplish in comparatively short time what nature might take generations to do if, and when, she got around to it.

A stumbling block to breeding has been the difficulty in producing hybrids that are fertile, hence capable of reproduction. Sterility

Courtesy Boyce Thompson Institute
Hard-to-root holly. An example of chemically induced roots

is the rule, fertility the exception or the happy accident These accidents are produced in nature without regard for time, and man's only improvement over the natural process has been to multiply the chances of an accident by mass planting and crossing Colchicine, while not infallible, increases the number of chromosomes in many plants—doubling, tripling, quadrupling, dropping one chromosome off or adding one—to produce fertile hybrids Thus the progeny, in turn, become capable of breeding, and the work of crossing, re-crossing, and back-crossing can proceed apace until the desired qualities have been assembled within a single plant

It is conceivable that hybridizers may be able to use chemicals on annuals and give them a perennial quality This would eliminate yearly planting It might be that perennials could be endowed with qualities found only in annuals There can be breeding to give plants resistance to diseases This last has been accomplished already by older methods of trial and error, but now it can be done with more speed and certainty Perhaps colchicine will produce results which never could come about by the happy accident system If this proves to be true, the potentialities of the drug treatment can hardly be estimated at this stage of development

The most recent chemical to be put before the public is Vitamin B-sub-one Extraordinary claims are made for it, but very few can be substantiated Certain species, notably camellias, orchids, and gardenias, are said to profit greatly by its use, probably because the plants cannot themselves produce enough of the vitamin for proper growth All plants must have the vitamin, but most plants manufacture it and most soils have it in sufficient quantity If the humus content of a garden is adequately maintained, use of the vitamin is superfluous

If one tracks down to its source a tale of great success with Vitamin B-sub-one, it will be found very generally that the user has neglected to establish controls Unless untreated stock is planted side by side with treated stock, no valid conclusions can be drawn "Bigger and better" must always be qualified by reference to some controlled standard

All this work with chemicals has great significance It is widening our knowledge of plant life and opening new vistas for scientific exploration. Scientists and hybridizers will carry the work forward, but even the layman, if blessed with bright green thumbs, can make a contribution. There are a host of variables and unknowns left to be worked upon in the field and every successful field operation can be a contribution

But don't forget Plant chemicals are not labor-saving devices, nor are they panaceas for horticultural ills If their role is not fully appreciated, there can be bitter disillusionment If applied commercially at this stage by those who are inexperienced, they afford a quicker way to dissipate a fortune than raising chickens They are, on the other hand, excellent tools for better and more intelligent plant cultivation, and their use offers the amateur an A1 hobby

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EFFICIENT TURBINES

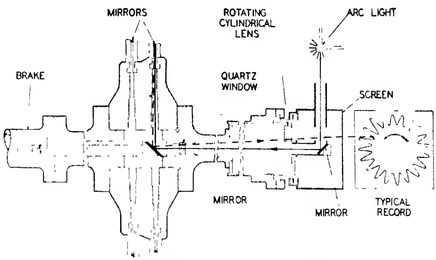
Cheaper Electricity Should Come From New Installation

MORE efficient and safer steam turbines, meaning cheaper electricity for everyone, should come from the new, full-sized but completely experimental turbine installation displayed recently at the Schuylkill Generating Station of the Philadelphia Electric Company

The man behind this research, expected to furnish the bedrock of experience for tomorrow's sources of power, is F T Hague, engineer of the Westinghouse Electric and Manufacturing Company In his laboratory studies he had pushed turbine steam operating characteristics up to 1250 pounds pressure and temperatures of 900 degrees—hot enough to melt lead What he needed for a final test was a life-sized installation and a plant boiler capacity which could create the 125 tons of steam needed, each hour, to run such an installation The plant of the Philadelphia Electric Company provided such capacity

Moreover, this installation had to have some means of looking inside it and seeing how the turbine blades were vibrating under the extreme shock "To form a mental picture of this shock," Mr Hague explains, "imagine a turbine blade moving 350 miles an hour abruptly entering a steam jet density moving 1200 miles an hour" Oscillations at the rate of 126,000 times a minute occur in the blades, or 181,-440,000 per 24-hour day

Just as trees sway in a gale, so, too do the turbine blades sway and



Optical system of the set-up for studying turbines in operation

vibrate under this super-hurricane of hot, "live" steam If the vibrations are just right the blades enter into what engineers call resonance Eventually they break off as their sway becomes greater and greater

While the turbine blades are whirling some 60 revolutions a second around the turbine shaft, an automatic camera takes pictures through a tiny quartz window in the shaft at the rate of two a second

"With this new apparatus," Mr Hague explains, "a beam of light is carried through the shaft of the turbine and up into the blade itself, where mirrors reflect it out again, faithfully recording all vibrations In this manner the harmonic movement of the blade can be recorded on film for any stated condition of operation

"The light beam, supplied by an arc lamp, is deflected by a stationary mirror into the rotating shaft," he pointed out "A slanted mirror inside the shaft throws the light beam through a hole in the rotor disk and then through a smaller hole inside the blade, towards a small curved mirror on the end of the blade This curved mirror sends back the light by way of the slanted mirror in the shaft, to a screen

"When the turbine rotates without vibration, the light point on the screen describes a circular path But when the blade vibrates, the curved mirror mounted on the end of the blade deflects the light beam away from this path and waves or notches appear on the circle The wavy circle described by the light is recorded on film by a specially designed speed camera

"By study of the resulting pictures the stresses on the blades are deduced directly from the magnitude of the waves by proper calibration By shifting the mirrors, it is possible to measure side-to-side as well as back-and-forth vibrations "—*Science Service*

STAR "JACKETS"

Iron Shells May Yield New Information

FROM iron "jackets" which encase certain stars and give out peculiar kinds of ultra-violet light, incapable of reproduction in laboratories, physicists hope to learn more about the atomic structure of important earthly metals

Reporting in the *Astrophysical Journal* on researches he has made at the McDonald Observatory of the Universities of Chicago and Texas, Dr Otto Struve, director of the Observatory and also of the University of Chicago's Yerkes Observatory, declares

"The importance of this work consists in the fact that it provides information about some of the most common and useful substances, including chromium and titanium as well as iron Such information can be found only in the stars "

The metallic jackets around these stars are in gaseous form, at temperatures far higher than the boiling point of iron Subjected to this intense heat, the atoms give off radiations which cannot be produced on earth, partly because there is not enough gaseous iron on the earth, and also because such high temperatures cannot be reached For this reason, physicists refer to these radiations as "forbidden " — *Science Service*

Three X-ray snapshots of bullets piercing blocks of wood In center photo, note trail of lead; in right photo, bullet literally explodes wood

X-RAY SNAPSHOTS

Millionth of a Second With New Ultra-High Speed X-Ray

A RIFLE is fired in the research laboratory, and a bullet tears through a block of wood placed between an odd looking glass tube and a flat aluminum box A football player boots the pigskin from its strange perch atop the same box A golfer drives a ball from a makeshift paper tee on the box

And in one millionth of a second —less than one twenty-thousandth of the time required to blink an eye —the glass tube produces and releases a heavy surge of penetrating X-rays A few minutes later, on an X-ray film taken from the aluminum box and developed, Westinghouse research engineers can learn exactly what has happened during the millionth part of a second as the bullet plowed through the wood, the football player kicked the ball, or the golfer made his drive

Development of a new ultra-high speed X-ray tube which enables engineers to make these fast X-ray "stills" was announced recently by Dr Charles M Slack, research physicist for the Westinghouse Lamp Division

Westinghouse engineers believe development of the tube may presage a day when many desirable and hitherto impossible tasks may be accomplished Machine and motor builders, for example, will be able to study internal strains in rapidly moving parts Makers of sporting rifles, shotguns, and ammunition may determine any slight deflection of a bullet in its passage through a gun barrel, or observe the distribution of shot at various points in its flight from shotgun shell to muzzle It is even held possible that X-ray motion pictures may be made of such parts and objects, and many others

ATOMIC POWER

Released Spontaneously By Uranium

ATOMIC power is released from uranium spontaneously without atom-smashing bombardment with neutrons, two Leningrad physicists report in the *Physical Review*, American Physical Society journal But the observations of the two Soviet scientists, Flerov and Petrjak, hold out no hope that there will be any practical utilization of this energy from the splitting of the uranium atom Only six fissions an hour were discovered —*Science Service*

Physics In Court

Computations by Which Police Can Work Out Driving Speeds from Skid Marks after Accidents

C. W. SHEPPARD

ALTHOUGH the determination of the minimum speed of automobiles by the length of their skid marks has been known in courts of law for a good many years, it was not until quite recently that it was put on a systematic basis Since 1938 such cities as Evanston, Illinois, and Pasadena, California, have been keeping a systematic record of all skid marks left on the street after traffic accidents, and in the later city, due to the unceasing efforts of Police Physicist William W Harper, such evidence has become of increasing value in convicting law violators

Let us consider a typical case which recently came before a western court A man and his wife were crossing the street It was after dark, and in a section of the city which is not too well lighted A driver ran into them, inflicting severe injuries Measurements showed that the car skidded 65 feet after the driver applied the brakes. From simple calculations based on this evidence, his speed was shown to have been at least 40 miles per hour and, even in the absence of eye witnesses, he was convicted of exceeding the speed limit, on a basis of the skid alone

The computations involved in such a case are simple Those who can recall their elementary physics will know that the distance d, which a body of velocity v will travel under a deceleration, a, is given by the formula $v^2=2\,ad$ This formula can be changed slightly to be more useful If v is given in miles per hour, d in feet, and a is expressed as K (its percentage of the acceleration of gravity) the equation becomes $v^2=30\,Kd$ To illustrate, let us suppose that a car has a braking power, K, of 70 percent This means, that, during a stop, it will have a force on it equal to 70 percent of its weight, which will slow it down at the rate of 22 4 feet per second every second This would be approximately the conditions encountered on dry pavement with ordinary tires

The value of K is known for a good many types of tires and road surfaces, but, unless it is impossible to do so, calculations are based upon test skids made with the car itself This method makes use of the fact, as seen from the formula, that the length of a skid increases as the square of the speed of the car One must remember that, once the car begins to skid, the length of the skid becomes a matter of tire and road surface, independent of the effect of the brakes Any wheel which is not skidding will be so close to skidding as to be under substantially identical forces The procedure is as follows Assuming that the car is not severely damaged after the accident, three trial skids are made at a speed of 20 miles per hour and under carefully controlled conditions From the known law of skid distance, the minimum speed of the car before the accident may be found by simple arithmetic or by the use of a chart devised by Mr Harper

These charts, on especially prepared cross-section paper, permit speed in miles per hour to be arrived at quickly, and include allowances for varying co-officients of friction. They also serve as a permanent record of the several factors entering into the skid-speed test of the car.

Making skid tests requires that the car should not have been badly damaged Nevertheless, in the case of severe damage it is still frequently possible to estimate the speed of the car by the quite accurate information now available as to the friction of tires on various kinds of pavement Estimates of this type can be made by an experienced man and, though not quite as accurate as in the case of skid tests, they nevertheless often show conclusively that the car in question was exceeding the speed limit In one recent case a car left skid marks 145 feet long and was demolished in a collision in which five people were killed When a K of 70 percent was assumed, a minimum speed of 55 miles per hour was given To this was added the conservative figure of ten miles per hour for the velocity absorbed in the collision damage, showing that the original speed was clearly greater than 65 miles per hour

AS one might expect, courts have been slow to accept skid-mark evidence as conclusive Judges have sometimes consented to witness tests of the reliability of the method One such test was made in Pasadena. In Mr Harper's absence a skid was made at 33 miles per hour He then was permitted to

Skid marks 60 feet long, left by a car at the scene of an accident. Marker boards are shown laid on the pavement at ten-foot intervals by the police

From a movie taken at Edison anniversary dinner, December 20, 1909. Mr. Edison left of center; Mr. Smith (see article below) second from left

measure the marks and calculate the minimum speed With little apparent difficulty he quickly determined the speed as being greater than 31 miles per hour

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EDISON

One of His Co-Workers Supplies An Anecdote

RECENT interest in the activities of that Grand Old Man of Inventors, Thomas A Edison, engendered by two motion pictures built around his life, gives added value to the photograph reproduced on this page This picture, taken from a Mutoscope movie made in 1909, is claimed to be the first motion picture for which Mr Edison ever posed

For the reproduction of this illustration we are indebted to Mr Albert E. Smith, now of Hollywood, California, and formerly associated closely with Mr Edison. The occasion on which this movie was made was one of Mr. Edison's anniversary dinners, given on Monday evening, December 20, 1909

"Every year the moving picture producers of that day," writes Mr. Smith in a letter to the editor, "gave Mr. Edison an anniversary dinner at the Plaza Hotel On this particular occasion, before we went to the Plaza, we went to the old Vitagraph studios in East 14th Street and D. W Griffith took the picture

"I was very well acquainted with 'the Old Man,' " continues Mr Smith "He was called this affectionately by all who knew him. Usually at these dinners I would sit on Edison's right, not as a seat of honor, I think, but because my voice was high pitched and penetrating and the right was his better ear

"Of the many stories told me by Mr Edison is one that I think will bear re-telling It regards the sale of his first patented invention—the duplex telegraph system A group of men in New York had offered to buy the invention Mr Edison talked it over with his wife and they agreed that he should ask $3000, if the buyers would not pay that amount he would come down to $2000 but that was to be the lowest

"Mr Edison met the group in New York and after some small talk they asked him if he had arrived at a price Mr. Edison told me that he was so nervous that he stammered and could not get the figure out A dictatorial man among the group of would-be purchasers of the system broke in with. 'Now, it's no use asking us a big price, Mr Edison We have made up our minds what we will pay and we won't pay a cent more In fact, I may as well tell you that $40,000 is our limit' Edison told me that he nearly fainted but rallied enough to assent.

"The contract was drawn up," continues Mr Smith, "and Edison stipulated that he was to be paid in cash, in $5 bills One of the men tried to talk him into taking a check but Edison did not trust banks and very plainly said so On the day of settlement he went to New York, signed the papers, and was paid the money With the bills stuffed in the pockets of his suit and overcoat, Mr Edison started home, fearing that every man who looked at him knew that his pockets were full of bills

"When Mr Edison arrived home he was in such a funk that he sat up all night near the kitchen stove with a double-barrelled shotgun across his lap By morning he was nearly exhausted and decided to take the advice that had been given So he went back to New York and found the man who had previously suggested placing the money in a bank On Mr Edison's request, this gentleman took him to a bank and helped him to open an account

"Edison, in telling me of this experience," concludes Mr Smith, "said that he then went home and within a month had spent all the money I was astonished and asked him how he had spent it His reply was, 'On machinery I had never before had a machine shop Then I had a good one' "

INVENTORS AID

Physics Course Gives Background Knowledge

INVENTORS and others who lack formal training in the fundamentals of physics, or who wish to review the subject, will be interested in a special course to be conducted this fall and early winter Held at New York University, under the direction of Joseph H Kraus, the course will include rudimentary principles of physics and their practical applications in a wide variety of industrial fields

At each session of the course there will be an open forum for discussion of new inventions, proposed developments, and so on

FLUXES

Aids to Welding And Soldering

THE paradox of welding aluminum at a temperature below the melting point of the metal is achieved by the use of a welding flux developed by the Alwarth Chemical Corporation The new flux is used to coat the ordinary welding rod which contains approximately 5 percent silicon. The weld may then be made

without sweating the parent metal; hence, the area adjacent to the weld retains its full strength and ductility

Another flux for use on stainless steel, and made by the same company, is said to eliminate the unpleasant fumes ordinarily present in stainless steel soldering

Still another flux may be used on rusty iron, dirty brass or copper, or, in fact, any metal except aluminum By its use, retinning of rusted surfaces can be done with a minimum of labor

AVALANCHES BOMBED

Explosives Break Loose Snow and Ice

WHILE much of Europe has felt the destructive power of bombs in recent months, at least one country has been using these deadly missiles for a beneficial use Switzerland is

Starting an avalanche

using them to shoot down avalanches under control

Each year in the Swiss Alps there are many victims of natural avalanches Mountain climbers are often caught in them, and there is a sad record from the first World War indicating that on a single day in December, 1916, over 10,000 soldiers stationed in the Tyrol mountains of old Austria fell prey to avalanches.

In the Alps, the blanket of snow is now regarded almost as a live thing that can become a deadly menace to humans Hence the Swiss have established a Snow Avalanche Research Station above Davos — the only one of its kind in the world This station can foretell avalanches and issue necessary warnings Furthermore, if the avalanche location can be reached, hand grenades are used to start it moving If big avalanches are involved, their descent is started by trench mortars

This work is being carried on constantly to safeguard the lives of skiers, of travelers over alpine roads, and of soldiers stationed in the mountains The new method eliminates the great danger of the large spring avalanches which formerly, uncontrolled, often destroyed homes, bridges, highways, and roads

SNAP RIVET

"Bachelor's Button" Fastener For Metals

A NEW spring locking button and fastener stud provides a rivet-type fastener for many uses This button will substitute for the present speed nuts and screws and other types of nuts, and in exposed places it will have a finished appearance It is so designed that it will not loosen from vibration It is an invention of David Hoppenstand and is produced by the Hopkan Rivet Company

The fastener stud has a head and a shank like the average rivet, but the shank is tapered toward the end and provided with a number of parallel ring grooves The spring locking button is made of thin sheet steel with locking lugs extending inwardly from the opposite edges of the curved shell These locking lugs grip the rings on the shank of the stud

Because of its simplicity and the ease with which it may be installed, this new fastening unit may be used in the automotive, aircraft, and refrigeration fields It can be made

Snap rivets and applicator tool[redacted]

from any type of alloy, and the spring locking button can be made in any shape — circular, flat, diagonal — and in any size

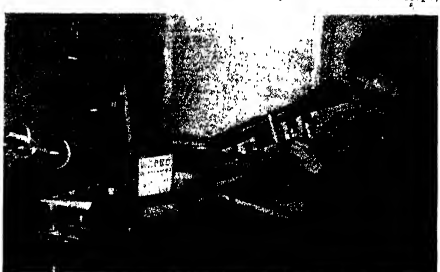
HAM TELEVISION

New Transmitting Tube Now Available to Amateurs

INEXPENSIVE, a television camera "eye" tube which opens the field of electronic television to thousands of American radio amateurs, is a much simplified version of the more familiar "iconoscope" television camera tubes used in studio cameras It is being placed on the market to sell at slightly less than $25

With the new iconoscope, it is practicable for the first time for the amateur to build a complete electronic television transmitting and receiving system at a total cost of approximately $300 or less, depending on the equipment which he has at hand Amateurs who now have 2½-meter transmitters will find it relatively simple to adapt them for sending television signals alternately with sound broadcasts

The 120-line pictures transmitted by the amateurs' iconoscope,



Radio ham televises his call letters with new transmitter tube

while not of the same excellent quality as the 441-line television images being broadcast in New York, are remarkably clear and sharp, equivalent to newspaper half-tone reproduction The new iconoscope transmits a television picture about 1½ inches square which may be enlarged at the receiver

In research and development work on this new unit, RCA Laboratories collaborated with the American Radio Relay League, which has been seeking for several years to make it possible for the amateur radio enthusiasts to enter the television field All the necessary equipment has been available for some time for amateurs, with the exception of the iconoscope Television receiving tubes, or kinescopes, have been available in sizes as small as three inches

It is believed that the opening of the electronic television field to amateurs will serve to widen existing popular interest in the new art, and at the same time accelerate progress in television development The radio industry today points to a number of important steps pioneered by American amateurs, including the development of new circuits Radio amateurs were among the first to demonstrate the enormous possibilities of short waves, a region which at the time was not highly regarded for radio purposes

LIFEBOAT

Oarless, Motorless Boat Has Screw Propeller

READY for service in troublous times, the U S liner *America* is prepared for any emergency Fourteen of her lifeboats, for example, use a manually-operated system of push-pull levers instead of oars or

Push-pull levers in lifeboats

Levers operate a propeller

motor This method gives passengers something to do, eliminates confusion caused by inexperienced oarsmen

The propeller to which the levers are geared had to be designed within definite size and weight limitations. The Federal-Mogul Corporation solved the problem in an unusual manner They adapted their original "Equi-Poise" design, created for the propellers of Gar Wood's famous speedboat *Miss America X*, to the new lifeboats They then cast the wheels from Lynite, an alloy developed by the Aluminum Company of America, which cuts the propeller weight to one third normal, and has high resistance to salt water corrosion

Any number of crew or passengers from one to sixteen can operate the simple push-pull levers —and they don't have to work in unison—to move the boat It has a maximum speed of six miles per hour

The idea behind these novel lifeboats is that they will provide sufficient speed quickly to carry a large number of people away from immediate danger, and thereafter they can be towed by the *America's* power-driven lifeboats

WOOD SEASONING

Urea Prevents Drying Losses

CRYSTAL urea is now being used as a chemical seasoning agent to prevent checking, splitting, and such losses as occur in drying lumber in the air or in the kiln Fresh-cut lumber dries first at the surface, but when treated with a solution of urea, the outer surface remains moist and drying proceeds from within, thus eliminating the stresses that cause trouble.

This treatment is easy to apply, permits faster and more severe kiln schedules, thus increasing the plant output. Urea, non-toxic, stable and harmless to the skin, is not corrosive to metals used with wood or to tools or knives employed in dressing lumber Urea-treated wood is also less flammable and less susceptible to attack by fungi and rot than untreated wood

Mill-scale treatments on Douglas fir and hemlock in the Northwest and on red cypress in the South are now being made Tests are in progress on other woods —*The duPont Magazine*

STREET CARS

Modernized for Modern Service

ALTHOUGH people generally have the idea that street cars are on the way out, these vehicles continue to be improved so that they render in-

Controls on a modern street car

dispensable service in certain localities San Francisco, for example, has just put into service a number of streamlined street cars which operate and stop without a jar or jolt, ride smoothly even at rail intersections, and, in fact, give service that is modern in all respects Our photograph shows the manner in which the motorman's cockpit has been modernized, following in general the design of automobile dashboards

JAP BEETLES

Yellow Traps Found Most Effective

THE bright yellow color of the Japanese beetle traps set in 1940 by the Bureau of Entomology and Plant Quarantine of the U S Department of Agriculture is the result of research developments in tests last season Most beetle traps had been green, or green and white The "scouting" traps widely distributed by the Federal entomologists were uniform, but traps on the open market were available in many shades of green, and the

beetle research organization decided to investigate differences in attractiveness, to the beetles, of the various shades of green, as well as of other colors This investigation showed that traps painted yellow caught approximately 50 percent more beetles than the standard green and white traps Yellow pigment added to any other color of paint increased the numbers of beetles captured

PLANT TAGS

Metal Labels Provide Permanent Identification

A SPECIAL alloy of metal, flexible and resistant to acids and ground chemicals, has solved one of the most annoying problems of gardeners Professor Aden J King, who is a gardener as well as a college professor of chemistry, has used this metal to make a plant label Since it is similar to a very heavy foil, a soft pencil is all that is necessary to print the name of plants or shrubs on this new Perm-A-Tag The printing makes a permanent impression in the metal The user may, if he so desires, mount the strips in his typewriter and type the names thereon After that a tongue and slot arrangement makes it easy to loop the label around a plant or shrub and clamp it firmly without the use of any tools

EYE PROTECTION

Variable Sun Glasses Give User Control of Brightness

THE conventional sun glasses with tinted lenses offer only one degree of brightness control for the wearer Polaroid sun glasses sold in previous years, while they provided better protection for the eyes against the glare of sun, still offered one degree of brightness control However, the Polaroid Corporation has now developed a Polaroid

Set for maximum transmission

Set for minimum transmission

Variable Day Glass which permits the wearer to control the brightness of the view

Instead of only one lens before each eye, the new Polaroid Variable Day Glass has two lenses The front lens before each eye is stationary in the frame while the two rear lenses may be rotated by a convenient button on the bridge of the frame Simple movement of this button with the finger rotates the rear lenses so that more or less light may pass through, according to the angles between the polarizing material in the front and rear lenses Thus the wearer may cut down light transmission on a very brilliant day or allow more light to pass through on a duller day Adjustment of the lenses may always be such as to provide the greatest comfort and efficient vision for the user, regardless of his particular tolerance for excessive brightness

POST DRIVING

Small Explosive Charge Drives Piling or Posts

OFTEN it is essential to put a pile or post in water or wet ground where a pile driver is not available, or when so few piles are to be driven as not to warrant bringing in a heavy piece of equipment.

A method has been worked out whereby the force of dynamite can be used to transmit a blow which is somewhat similar to the dropping of a pile driver hammer The pile is stood upright in the location desired, and braced in place—usually with rope The head of the pile should be sawed off square and the procedure is to put a heavy plate of steel on top of the pile To give the best results, the plate should be one inch to 1½ inches thick One stick of dynamite is placed on top of the plate, and covered with mud after the stick has been properly primed with a blasting cap and fuse or an electric blasting cap When the charge is exploded, the force is transmitted to the plate which in turn transmits it to the pile The pile is driven into the ground sometimes as much as 14 inches if the ground is soft The procedure is then repeated until one inch penetration per explosion is obtained —*Agricultural News Letter* (du Pont).

FLASHLIGHT

Rod-like Gadget Extends Any Flashlight

FOR use in inaccessible places, a flashlight bulb extension has been developed Made in lengths of from six to 36 inches, the extension's

To get light where needed

plug is screwed into any flashlight; a bulb is in the socket on the other end Being bendable, the extension can be inserted into intricate mechanisms, or into bores on a lathe It aids vision down between walls, back behind fittings, inside of models, down among gears—in fact, any place where there is at least one-half inch clearance for the bulb end

Known as the Sierra Flashlight Bulb Extension, the device is made of special wire encased in aluminum alloy tubing

CHEMICAL GARDEN POTS

Home Plants May Now Be Grown in Chemicals

HOME experimenters in chemical gardening who have been handicapped by lack of suitable and attractive containers may now thank Ernest W Brundin for making chemical gardening pots and gardens available. This large commer-

cial grower of tomatoes in nutrient solution and founder of Chemical Gardens, Inc, has designed glazed, two-compartment, pottery containers in a variety of shapes and colors. Either seeds, seedlings, or mature plants may be grown in these

Mr Brundin's containers are made in two parts, the upper one

For feeding plants chemically

fitting into the lower one and making a complete unit of attractive design. The lower one holds the chemical solution in water The upper is filled with clean, sharp sand A terra cotta wick extends through a hole in the bottom of the upper section down into the water Capillary attraction supplies plenty of water and food to the sand bed above

Two small bottles of plant food concentrates are supplied with the chemical gardens, and last for many months A quantity of each solution is measured into a given quantity of water about once every 15 days, and the mixture poured into the bottom section. The chemical balance of the prepared liquids is such that changes made by the plant in the silica bed are constantly corrected automatically by the supply coming up through the wick

INSECT-REPELLENTS

There is no Plant Which Repels all Insects

THE idea that certain plants in the garden will drive away mosquitoes and all other insect pests is attractive, but unfortunately, says F C Bishopp of the United States Department of Agriculture, it does not seem to work out in practice No such plant is known. If any plant were a good repellent, it would probably be because it con-

tained some chemical substance offensive to all insects Scientists have sought such a chemical but never have found one.

There are chemicals effective against certain insects, but differences in sense of smell among insects appear to be as great as among the higher animals, says Bishopp, who studies insects that affect man and animals Don't put too much faith in chemical repellents or any other single type of protection against all insect pests, he advises

DUPLICATORS

New Method for Making Employs Photochemical Stencils

A NEW method of making duplicate copies of line drawings in quantity has recently been developed by A B Dick Company, makers of the Mimeograph duplicator The new Mimeograph photochemical printer

Drawing duplicator

makes possible quick, accurate transference of any opaque drawing to a stencil sheet for black-and-white reproduction

The chief element of the printer is a new cool, brilliant light source, unvarying in intensity, with remarkably low consumption of electricity and dependably constant results Around the evenly distributed light-tubing is a heavy, unbreakable transparent cylinder free of blemishes that might affect the exposure of the stencil sheet

To make the photochemical stencil, it is first made light-sensitive with sensitizing solution Next, the original tracing and the stencil sheet are exposed to light in the printer By this exposure the image on the tracing is transferred to the sensitized stencil sheet in a single step The stencil is then developed on the developing plate and placed on the Mimeograph duplicator for black-and-white reproduction of dozens or hundreds of copies, as desired.

The time of the procedure, from finished drawing to finished copies, is generally less than 25 minutes

Price of materials for producing the stencil—including the stencil sheet—is less than 25 cents.

Any size drawing up to 7¼ by 14 inches, on paper not larger than 8½ by 16 inches, may be used as an original. The only requirement is that the image on the original be thoroughly opaque and the exact size desired in the finished copies. India ink tracings on translucent cloth or paper are recommended for best results. Typewritten matter cannot be reproduced on the photochemical stencil.

The photochemical printer is portable and may be used in mechanical arts and music departments of schools, engineer's offices, and factories. A few suggested applications are quantity duplication of tracings for engineering, production, and sales engineering departments, erection and installation diagrams, graphic instructions of all kinds, technical illustrations for parts and instructional catalogs.

The printer requires alternating current, 60-cycle, 110 volts.

PAINT DRYER

Infra-Red Lamps Given New Job

MORE and more are infra-red rays being utilized for finish-drying purposes. These heat rays in suitable reflectors have been utilized for several years to dry very rapidly the lacquers on, for example, automobile bodies. Now small infra-red lamps have been given the job of drying many things around the home. At the flick of a switch the housewife may soon turn on lamps to dry the family washing quickly and economically, cook

Infra-red dries paint quickly

food, or heat a room or an entire house in cold weather.

Our accompanying illustration, used through the courtesy of Westinghouse, shows a particularly important use of such lamps for drying interior paints. In such use, household annoyance due to repainting is greatly reduced, or an apartment is made ready more quickly for incoming tenants Furthermore, the paint is dried so quickly that there is little chance for dust settling on the surface

NAVIGATION TABLES

New Method Decreases Computation, Simplifies Study

A SIMPLIFIED method of determining the position of a ship or an airplane, eliminating nearly all the involved mathematical computation of older procedures, is now available for ocean commerce and modern, high speed, air transportation.

This new method is based on the use of navigation tables which are being computed and assembled by the Work Projects Administration in co-operation with the Hydrographic Office of the United States Navy WPA workers, under the supervision of the Hydrographic office, have assembled the tables in volumes covering 10 degrees of latitude, usable in both the southern and northern hemispheres Four volumes of this work are available to navigators, while a fifth will be available this year

Under ordinary conditions, a training period of at least eight months is necessary to develop facility in navigation With the new tables, it is estimated that the training period can be reduced to about six weeks. By using this new aid—called "H O 214—Tables of Computed Altitude and Azimuth"—a navigator either at sea or in the air can find immediately the altitude angle and azimuth, or bearing, which correspond to his assumed latitude and longitude without having to compute it

All U. S Government services, including the U S Navy, Coast Guard, Army Air Corps, and the Coast and Geodetic Survey, are now using these tables in their navigation and scientific work while an increasing number of private seamen, yachtsmen, and aviators of all nations are finding the easier method valuable

DRAFTING CAMERA

Huge Machine Copies Large Drawings Quickly

AN important new process by which engineering drawings are directly reproduced, photographically, on nearly any kind of surface (metal, wood, cloth, and paper, to mention a few) has been announced by The Glenn L Martin Company This new process is credited with much responsibility for the factory's mass-production methods in building airplanes, and is expected to have wide application in many other industries

An heroic-scale camera snaps pictures of large drawings, the negatives are developed, and the images projected back to large sheets of aluminum alloy sensitized with a special emulsion When such a sheet (maximum standard size used is 10 by 5 feet, but it could be larger) is placed in huge developing tanks, the drawing appears in all its preciseness on the surface in exact scale—or in fractional or multiple scales, if so desired

Thus there can be produced in

Laying out airplane parts drawings, later to be photographed

Looking through the giant camera with which photo prints are made on metal, wood, and so on

a matter of minutes any number of drawings which might have required days in redrafting. The company saved more than $80,000 last year in drafting alone. Engineering work is speeded tremendously. Tool designing and tool making gets under way more rapidly and more accurately. Production preparation starts quicker and changes are made more rapidly. And because there are plenty of the exact-scale drawings available, the whole effort of the several vital departments is co-ordinated, all of which adds up to incomputable savings.

The versatile process has many other uses in the plant. Where an experimental airplane is to be built, the master drawings, absolutely accurate in every detail, can be photographed directly onto the metal of which the ship is to be constructed and the parts cut directly from the material itself. If a wind-tunnel or water basin model of a projected airplane is desired, it is only necessary to call on the camera to scale down the lines instantly from full size to an eighth, or tenth, or any other fraction of the full size. An easy calibration of the camera turns the trick, saving perhaps weeks of redrawing to scale.

SOIL MOISTURE

Simple Test for Water in Farm Soil

A BLOCK of plaster of Paris the size of a match box, some wire, and a small electrical apparatus so simple to operate that no training is required, are all a farmer now needs to determine the amount of water in his soil. The new method of measuring moisture in the ground was developed by the soils section of Michigan State College. A continuous measurement of soil moisture changes can be made by the process without disturbing either the soil or the crop.

In this novel approach to agronomic and irrigation problems, a block of plaster with attached wires is buried in the ground and allowed to absorb water until an equilibrium between it and the soil is established. By using an ordinary piece of electrical equipment known as a Wheatstone bridge, a measurement is then taken of the amount of resistance to electricity offered by the block.

Since water contained in soil readily conducts electricity, the greater the amount of moisture present the wetter the plaster and the less the resistance. If the ground is dry, the block offers greater resistance. Many absorption blocks may be distributed over the growing area at various depths to provide a complete picture of water fluctuations and movements within the soil and to furnish numerous control points.

The lead wires can be buried below tillage depth. When a measurement is desired, the block is connected to the bridge and the resistance can be determined in from 20 to 30 seconds. The electrical apparatus, being portable, can be used with any number of absorption blocks.

When the resistance of the absorption block becomes constant at about 400 to 600 ohms, the soil in which it is imbedded is holding about the maximum amount of moisture desirable for the growth of most plants. On the other extreme, as the resistance of the block passes to 60,000 ohms, soil moisture is approaching a minimum level with regard to plant requirements. Few plants will thrive in this dry soil and most plants wilt if more moisture is lost.

RIVETS

Explosive Forms Heads Without Backing Up

IN constructing such machines as tanks and airplanes it is often necessary to rivet the shell at points where it is impossible for someone to back up the rivet in order to form a head. As long ago as 1937 the German Heinkel concern partially solved this problem by production of a hollow rivet containing an explosive. This rivet was to be inserted in the rivet hole

from the outside and, when heated, it exploded to form a shank inside to hold the plates together However, the explosive corroded the opposite surface of the plate and the cost was high Furthermore, Heinkel bombers shot down in England show that such explosive rivets are far from uniform and are used only in unstressed parts

The DuPont company has improved upon the explosive rivets by developing an explosive powder which gives complete uniformity of explosive force and, therefore, uniformity of the rivet heads that are formed by that force This powder is said to be non-corrosive and the cost works out at about three cents per rivet Riveting is done with a simple electric or benzine heating gun, the time for each rivet being about 1½ seconds

Besides facilitating construction, these rivets may also be used effectively in repair work A hole made by a bullet or a shell fragment might be trimmed out of a plane wing, a patch fitted in place, and fastened tightly by means of these rivets

"MAGIC" LANTERN

Visual Aid Throws Stereoscopic Pictures

For the first time in the history of the manufacture of visual aids for selling and teaching, an automatic projector for showing glass slides in three dimensions is now being made It is the Real Life Projector of the Three Dimension Corporation Slide pictures projected from this machine onto a screen and viewed through Polaroid spectacles give an appearance of true depth

The machine is entirely automatic in its operation, feeding automatically all the slides in a tray holding 35 When that is empty, it may be instantly replaced with another fully loaded

Business executives interested in showing the true contours of products, the true color of finishes, or the true texture of fabrics and surfaces, might use this device to advantage In lectures of many kinds and in many fields of education it would prove a welcome aid to the speaker or teacher.

"Magic" lantern up-to-date

PLUG-IN X-RAY

Portable Machine Has High Capacity

Portable and shock-proof yet having the 80,000-volt capacity of much larger standard machines, a new X-ray machine introduced by Profession Equipment Company promises to perform jobs hitherto impossible because of the bulk of older equipment It was designed and assembled with the co-operation of C E Waltman and Associates.

Portable X-ray

The new machine is demountable and easily portable in two small carrying cases, the total weight being only 64 pounds It plugs into a regular electrical outlet

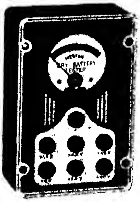
BATTERY TESTER

Pocket-size for Servicemen

A pocket-size battery tester to meet the need for a compact, inexpensive unit for correct testing of dry batteries under load, has just been announced Made by Weston Electrical Instrument Corporation, the new unit will be of particular interest to radio servicemen whose tube checkers do not contain provision for this important new test requirement, or wherever else dry

batteries should be tested under load

The pocket-size unit has been designed to fulfil the fundamental requirements for correct battery testing, that is, when the battery shows "good" on the instrument



To test dry cells under load

scale, it will be capable of delivering sufficient potential when under full load

In order to facilitate new battery sales and replacements, the scale consists simply of a "Replace — Good" indication, uncomplicated by voltage indications, which might be confusing to the layman Pin jacks are provided for the different battery voltages encountered — 1 5, 4 5, 6, 7 5, 45, and 90 volts

TRACING PAPER

Better Blue-Prints From Pencil Sketches

DRAFTSMEN often have occasion to make relatively complete drawings on tracing paper in pencil When blue-prints are made from these, however, the lines are usually very weak and never completely satisfactory The Frederick Post Company has developed a new paper called PTM which not only gives greater depth and blackness to the pencil line but also is more transparent than ordinary tracing paper The surface of this sheet is dull and has a sharp but very fine "tooth "

WAR GASOLINE

IT is figured that one day's operation of a fleet of bombing and pursuit planes necessitates the consumption of an amount of motor fuel sufficient to operate 3000 American passenger cars for a full year!

Data show that 2400 bombers consume about 288,000 gallons per hour, 1600 pursuit planes consume 160,000 gallons per hour Total daily consumption, on the basis of five hours in the air, exceeds two and one-quarter million gallons of fuel

Consumption by tanks, trucks, armored cars, motorcycles, and other motorized equipment is believed to be even greater —American Petroleum Institute

RUST PROOF NAIL

Unique Design For Boats Out-Holds Screw

A NEW rust-proof nail of odd and unique design, developed for the boat-building industry, has revealed in a series of tests an unusual combination of properties which indicate its value for a wide range of industries where corrosion is encountered In a special demonstration for naval architects it outheld a screw

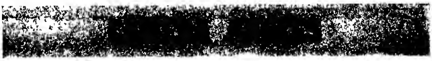
The nail is made of Monel and its holding power is derived from a series of sharp annular rings rolled-on in manufacturing operations These rings are sharp and set at such an angle that in driving

Annular rings, rolled-on, give nails unusual holding qualities

they won't disrupt the fibers of the wood The nail can be driven quickly without drilling a pilot hole—even into oak—and it requires no clinching

Another feature of this new nail is an exceptionally heavy head, in the case of a two-inch nail, the head is 5/16 of an inch in diameter and 1/16 of an inch thick The heads are two gages heavier than in wire nails of corresponding lengths

An outstanding property of the nail is that it is permanently rust proof and highly resistant to salt water and other agents of corrosion, including tannic acid Thus it will not produce a stain to discolor the wood into which it is driven



Conducted by JACOB DESCHIN, A.R.P.S.

Careers in Photography

Hobbies frequently lead enthusiasts to full-time trades and professions. This is particularly true of photography, especially since it may often be used in combination with some other activity either in an auxiliary capacity or as the main vocation Some of the numerous fields in which photography plays or can be made to play an important part were discussed at a recent Conference on Photography held in New York City under the auspices of the Institute of Women's Professional Relations, of Connecticut College Although slanted from the point of view of the girl graduate in search of

By Martin Lansen from the Fourth International Leica Exhibit
Professional. Portraiture

a job, most of the speakers described the requirements and opportunities in their several fields as they applied to all beginners without regard to sex

More than 20 major photographic fields were discussed by authorities in each field, but the general opinion seemed to be that the photographer who desires to make a success of his chosen profession must have a good technical training, good general background, and a good knowledge of the particular field in which he expects to work In addition to mastering the technical problems of photography in his field, said Roy E Stryker, Chief, Historical Section, Bureau of Information, Farm Security Administration, the photographer "must recognize that photography is a product of the intellect rather than a product of mechanical skill" Mr Stryker, covering the subject of "Photography in Social Science Research," said. "In order for the Farm Security Administration photographers to do their camera reporting they must be something of sociologists, economists, historians That they be expert camera craftsmen is taken for granted. That they have a good general background coupled with the faculty for acquiring a working knowledge of a variety of subjects is essential"

Nor did the speakers fail to warn prospects that photography is not easy work, particularly in the news-picture field. "Camera work has its share of heartaches and disappointments," said William Eckenberg, of *New York Times* Rotogravure. "One must be ready at any and all times to work 24 hours and more at a stretch and often go without food News photographers must be hardy enough to withstand all kinds of weather and abuse. Many of them have sacrificed home life and even life itself, in the pursuit of news pictures"

To beginners looking for an opening, Miss Jackie Martin, A R P S, Photographer and Art Director of the Washington *Times-Herald*, speaking on "News Photography and Photo-Editing," gave the following sound advice

"I should think the best chance for a job would be a small finisher or portrait studio, free lancing for papers or magazines (this very small pickings, however), join camera clubs, submit prints for exhibits, get jobs in photo stores which are hopping up like mushrooms Develop ability to write and make pictures, for the coming of tabloid type or caption type of story makes that an ideal combination I think the big thing is to learn about photography, be trained, and the opportunity to work at it will follow"

Although the conference was slated to discuss photography as a means of recreation as well as a profession and an adjunct, only one speaker discussed the recreational aspect This was Frank Liuni, president of The Photographic Society of America and The Metropolitan Camera Club Council, who described photography as "an indispensable adjunct to a wider enjoyment of life, even if one does not aspire to technical or artistic excellence"

The value of a good working knowl-

Courtesy Devin Colorgraph Corp
Adjunct: Illustration

edge and scientific background in the particular field chosen by the photographer was patent in the very subjects discussed by the various speakers These included papers on photography in biology and medicine, by Earle B. Perkins, director, Rutgers University, Department of Biophotography, chemistry, by Wanda K Farr, director, Cellulose Department of the Chemical Foundation, Boyce Thompson Institute for Plant Research, Inc, "Photography in Industrial Research," by John Mills, director of publications, Bell Telephone Laboratories, "Cinemanalysis A Psychological Research Technique," by Dr Arnold Gesell, director of The Clinic of Child Development at Yale University, "Guidance Through Visual Expression," by Evelyn S Brown, of Harmon Foundation, New York City, "Cinematography in Graduate Studies," by Robert Chambers, of New York University

Other subjects covered included "Aerial Photography as a Profession," by William H. Meyer, Jr, general manager, Fairchild Aerial Surveys, Inc, "Photography in Advertising," by Walter B Geoghagen, president of the Art Directors Club, "Civic Documentary History," by Berenice Abbott, "Theatrical Photography," by Florence Vandamm, F R P S, a talk on photography as a profession by Wynn Richards, "Women's Oppor-

Adjunct: Social

tunities in Public Service Film and Photo Agencies," by Arch A Mersey, assistant director, United States Film Service; "Photography in the Library," by Ralph H Carruthers, in charge of Photographic Service at New York Public Library, talks on various aspects of museum photography by G Lauder Greenway, assistant secretary, The Metropolitan Museum of Art, Beaumont Newhall, The Museum of Modern Art, New York, and Iris Barry, curator, The Museum of Modern Art Film Library; "The Teaching of Photography," by Franklin J. Keller, principal, Metropolitan Vocational High School; "Photography in Education, Educational Photography and Teaching Photography,"

Recreation: Hobby

by Adrian Ter Louw, Eastman Kodak Company Talks by Edward Steichen and Fairfield Osborn were discussed in a previous issue

Moral: Use a Stop Bath

If you allow light to fall on film before it has been fixed, the inevitable consequence is a completely ruined film At least, that's the way we have all been taught However, all is not necessarily lost in such circumstances, as witness the experience of a friend who did that very thing and yet saved the day After developing the film he poured the developer solution out of the tank and poured in the stop bath Then he was interrupted by visitors and upon returning to the tank forgot that the film was in the stop bath, not the fixer, and opened the tank He removed the films (he was developing filmpack) from the tank and found the tell-tale milkiness that indicated the films had not been fixed He washed the films anyway and let them dry About a week later(!), he attempted to mend matters by immersing the negatives in the fixer even at that late date, since there was nothing to lose and everything to gain The result surprised him The films "cleared" and became printable negatives All thanks, of course, is due to the use of a fresh stop bath, which arrested development and turned failure into success

Fine Grain, Germain

Designed by Morris Germain, A R P S, "as a foolproof developer for students and serious minded amateur photographers whose efforts in compounding photo-chemical solutions need encouragement," his fine-grain formula, given below, has met with popular favor with amateur and professional photographers alike.

Water (125° F or 52° C)	32 oz	or	1000 cc
Metol	¼ oz	or	7 gm
Sodium Sulfite	2½ oz	or	70 gm
Paraphenylene-diamine (base)	¼ oz	or	7 gm
Glycin	¼ oz	or	7 gm.

Mr Germain, who is Technical Advisor for Penn Camera Exchange, New York City, gives the following instructions: "The use of distilled water is preferred Dissolve the chemicals in the order listed. Use without dilution For replenisher, use the same formula Thirty-two ounces of this formula will

Fifth Annual Scientific American
AMATEUR PHOTOGRAPHY CONTEST

[For Complete Contest Rules, See Page 94, August 1940 Scientific American]

OVER $1200 IN PRIZES

36 PRIZES PLUS Three Special Awards

IN this year's contest, prints may be entered in any or all of the three groups listed below, in accordance with the rules In addition to the seven major prizes and five honorable mentions, there will be three SPECIAL AWARDS that will be accorded to the three outstanding photographs among the 36 prize winners *These special awards will be given in addition to the regular prizes that the pictures win.*

DIVISIONS IN WHICH PRINTS MAY BE ENTERED

Division 1 Human interest, including camera studies of people animals, and so on Portraits will be grouped in this division

Division 2. Landscapes, including all scenic views, seascapes, and so on

Division 3 Action, including all types of photographs in which action is the predominating feature.

THE PRIZES

1st. Three $125 LONGINES, Coronation Model, Solid Gold, Men's Wrist Watches.

2nd. Three $85 LONGINES, Presentation Model, Solid Gold, Men's Wrist Watches.

3rd. Three FEDERAL No. 246 Photo Enlargers (List Price $49.50).

4th. Three FEDERAL No. 345 Photo Enlargers (List Price $42.50).

5th. Three PIERCE CHRONOGRAPH Men's Wrist Watches (List Price $19.75).

6th. Three BERMAN-MEYERS Flash Guns complete with case (List price $15).

7th. Three FINK-ROSELIEVE Vaporators (List price $12.50)

HONORABLE MENTION

1st Three Fink-Roselieve "Hi-Spot" Hollywood type spotlights.

2nd Three Mimosa Perkino developing tanks.

3rd. Three Raygram Wood-Chrome Tripods.

4th Three Fink-Roselieve Audible Timers.

5th. Three Fink-Roselieve Satin-Chrome Range Finders.

THREE SPECIAL AWARDS!

Winning pictures in the three divisions will be grouped and judged further to determine which three of them shall be considered as the best in the entire contest To the contestants who entered these three photographs will be presented the following special awards

1st. One No. 715 Weston Exposure Meter (List price $24.)
2nd. One No. 650 Weston Exposure Meter (List price $19.95.)
3rd. One No. 850 Weston Exposure Meter (List price $15.50.)

THE JUDGES:

McClelland Barclay, artist
Ivan Dmitri, artist and photographer
T J Maloney, editor of U S Camera
Robert Yarnall Richie, photographer

Address all Entries to

Photograph Contest Editor, Scientific American

24 West 40th Street New York, N. Y.

develop 12 to 18 five-foot rolls of 35 mm film or its equivalent in area The developer should be filtered after compounding and again thereafter, each time before use This will insure against 'pin holes' from foreign matter or normal precipitates that may be present in the developer solution "

Among the advantages listed for this developer are good keeping qualities, maintenance of energy over a longer period of time with consistent use, no extra exposure compensation required Developing time is 8 to 10 minutes for film having Weston rating under 50, 12 to 15 minutes for Weston rating above 50

One Subject, Many Pictures

THE most obvious truths of photography have to be repeated now and then because people seem to forget them so easily As a result, they overlook pictures that are right before their eyes, but take some study to see One of these truths is that a single subject may offer more than one shot Mrs Alterman, of Mount Vernon, New York, may have been thinking along these lines, or perhaps it was simply because she liked the particular spot, when she planned and shot a series of pictures around a certain wood fence

Two of these pictures are reproduced here Each one is distinctly different from the other It was just a matter of changing the viewpoint Personally, we like the close-up shot better than the "long" shot of the fence But that is just a matter of opinion In any event, a series would necessarily call for the inclusion of whole subject in at least one of the pictures, which may then be supplemented by close-up views of details

In addition to viewpoint, there is also the opportunity of photographing the subject in different seasons Mrs Alterman has done this as well, photographing the scene in the fall and again in the winter with snow instead

From one viewpoint . . .

. . . and from another

of fallen leaves to identify the season

This kind of photography is a sort of exercise which every worker should now and then indulge in even if he never shows the results It is the kind of experimentation that will stand him in good stead when the "real picture" comes along

Solution Bottles

RECENTLY we came across some empty gallon size brown bottles used by manufacturing chemists for packaging their chemicals, that struck us as being admirably suited for storing or mixing photographic solutions The large Bakelite threaded cap is about an inch deep, has a wax coating at the bottom of the cap to preserve the contents of the bottle, and the neck of the bottle is designed with an indenture at the edge to hold the bottle on the rim of the graduate or bottle into which the solution is poured

If you have a chemist friend by all means get him to let you have one or more of these bottles as he empties them If he can spare them, of course They seem ideal for mixing large quantities of solution for distribution among several smaller bottles, or even for storing solutions One worker mixed a gallon of paper developer in one of these and used the bottle for storage Although he kept pouring from the bottle occasionally over the course of several months, gradually depleting it, there seemed no evidence of serious oxidation

Daumier and Candid Photography

COMMENTING on a group of Daumier's sketches as paralleled in the work of some of today's candid photographers, Ralph Steiner, writing in a recent issue of *PM*, remarked on the similarity in viewpoint of the artist and the photographer

"The candid camera photographer today can catch in a fraction of a second a gesture, an expression or a pose that the painter may labor over for hours," writes Mr. Steiner. "But just because the painter works slowly, he is more likely to choose significant gestures—ones that express the relationship of people to each other, or that express their feelings, thoughts, characters

"This should be the job of the candid photographer also, but too often today he is interested only in the fact that he can take the picture at a 1/1000th of a second, and catch an accidental gesture, like the politician de-waxing his ear

"The good candid photographer should play the same part as a recorder of human thoughts and feelings as a painter such as Daumier played for his time"

Kalart Contest

MORE than $500 in merchandise prizes is offered by The Kalart Company, Inc, 915 Broadway, New York, N Y, for pictures taken with a Kalart Speed Flash, both outdoors by the Synchro-Sunlight method, and indoors This year's contest, which is wider in scope than in former years, offers a total of 35 grand prizes including an Anniversary Speed Graphic as the First Grand Prize, a Simmon Super Omega B Enlarger, a Solar Enlarger, a Federal Enlarger, a Kalart Lens-Coupled Range Finder, and other prizes

Any number of prints may be submitted, either mounted or unmounted

In addition to the 35 Grand Prizes, the Kalart company each month will award a case of Wabash flash bulbs and a new Kalart Concentrating Reflector for the best photograph received during each of the following months August, September, October, and November All entries received up to and including the last day of these months are eligible for the monthly prizes Speed Flash photos winning monthly prizes will also be eligible for Grand Prizes

The contest closes at midnight, December 1, 1940 Entry blanks are available from photographic dealers or by writing to the company

100 Years of Progress

A HUNDRED years ago and today in photography is strikingly illustrated in this picture, which needs no caption A Daguerreotype camera that was all the rage a century ago looks crude and cumbersome to us

Then . . . and now

today, accustomed as we are to the finest of precision cameras The implication is, of course, that we feel mighty proud of our accomplishment But we must consider that had it not been for the Daguerres of yesterday, photography might never have achieved what it enjoys today

Window Reflections

WHAT you see, you can photograph. This is not always appreciated by the amateur worker as much as it should be For example, a reflection in an open window of the sky opposite

Reflection

to that part of it which you happen to be facing, can be photographed, as it was in the accompanying illustration You will notice that the reflected part shows up bright and properly exposed, while the portions faced directly by the lens are overprinted This is, of course, due to the fact that the reflected buildings were lighted by the sun

The Lens Club

DESCRIBED as "the most unusual camera club in the world," the Lens Club, whose headquarters are at 165 West 46th Street, New York City, is out for members The club hopes to serve as the national headquarters for the professional photographer and pioneer in the industry Its first objective, however, is to help its amateur members to perfect their technique and provide working facilities

Chief responsibility for organizing the club is credited to Herbert Mitchell, known as the "Photographer of Celebrities," and a list of distinguished names constitutes the Advisory Board.

The club is characterized by its sponsors as "three clubs in one," combining the best features of the camera club, the social club, and the luncheon and dinner club. The clubrooms are the former home of the Motion Picture Club, occupying over 13,000 square feet of space

When completed, the announcement says, the club's facilities "will include a studio fully equipped for black and white and color work, darkrooms and finishing rooms, lockers and dressing rooms, showers, beauty parlor and barber shop, projection room and library, spacious and comfortable lounge, meeting room and exhibition room, dining room and kitchen, private bar, bridge and backgammon rooms." The formal opening will be September 1st, 1940.

Particulars may be obtained by writing to the club.

Cut Film Sizes

THOSE who use the so-called 2¼ by 3¼-inch cut-film size will be interested in the following letter recently received by this department from Lloyd E Varden, A R P S, of Agfa Ansco

"It has come to our attention repeatedly that there exists a general confusion in the two cut-sheet film sizes 2½ by 3¼-inch and 6 5 by 9 cm These two sizes, although representing a difference of only .06 of an inch in width and 04 of an inch in length, cannot be used interchangeably This applies both to the sheet film holders and to the film

"All sheet films are normally cut slightly smaller than their stated dimensions, in order to make them fit easily and smoothly into their holders The actual sizes are standard among American film manufacturers Discrepancies that have arisen in sheet-film sizes have been due mostly to camera importations, but no trouble will result providing consumers make sure to get the right size for their particular camera "

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WHAT'S NEW

In Photographic Equipment

DEJUR VERSATILE ENLARGERS Series will take in negative sizes from 1 by 1 up to 5 by 7 Model now available takes negatives 1 by 1 to 2¼ by 3¼. May be used as enlarger, camera for copying, camera for tabletop photography, camera for photomicrography, camera for portrait and still life photography, for Kodachrome and other three-color work, for transparency projection at any angle Completely ventilated housing utilizes "Aero-Teck" design permitting only minimum heat to reach negative plane.

LAFAYETTE PORT-O-LAB KIT ($6.89, complete) Complete darkroom set-up for developing and contact printing in handy airplane-style luggage carrying case. Maker suggests its use for developing and printing test prints while "on location," as well as convenience in small apartments where space is at premium Kit contains Bakelite roll-film tank for all sizes from 35mm to 116 size roll film;

printing frame, developing trays, contact paper, darkroom bulb, all chemicals and bottles necessary for complete work Carrying case measures 20¼ inches long, 13 inches high and 7¼ inches deep, weighs about 14 pounds including materials

LITTLE TECHNICAL LIBRARY (50 cents per book) A second series of books on various phases of practical photographic work, just issued by Ziff-Davis Publishing Company Each volume covers a separate subject and is written by a practical worker in the field The second series begins with book No 11, "Outdoor Photography," by Samuel Grierson, and concludes with book No 20, "Darkroom Handbook And Formulary" by Morris Germain, A R P S The others include No 12, "Indoor Photography" by Hillary G Bailey, F R P S, No 13, "Flash Photography," by Russ Arnold, No 14, "Photographing Action," by Victor De Palma, No 15, "Manual of Enlarging," by Stephen White, A R P. S, No 16, "Miniature Camera Technique" by Fenwick G Small, No 17, "Photographic Lenses and Shutters," by Richard W St Clair, A R P S, No 18, "Photo Tricks and Effects," by Jacob Deschin, A R P S, and No 19, "Selling Your Pictures," by Kurt S Safranski Each book is bound in stiff covers and contains about 25,000 words of text matter, illustrated

GEM FILMOLAC (60 cents)· Preservative for cine, still, and reversal film, against scratching, finger marks, brittleness, and curl

BESBEE CLOSEUP COMBINATION KIT ($3 75) For movie closeups of small objects, indoors and out Designed to work with any movie camera in making closeups of flowers, small birds and animals, botanical details, insects, and so on Kit consists of tripod table, which also can be used with camera handle (supplied), adjustable lens holder, universally adaptable to any 8mm or 16mm camera, and two closeup auxiliary lenses, giving sharp closeups of objects at distances of 10 to 30 inches Additional lens auxiliaries for other distances available in special assortment of six closeup lenses ($4) for distances 7, 12, 15, 18, 24 and 27 inches

ELKAY FOTO-PURE WATER FILTER ($3 50 complete) Designed to remove impurities in ordinary water May be attached to any faucet Outside made of Bakelite Inside consists of series of five metal screens, plus patented Cellulo fiber filtering disk.

F-R DEVELOCHROME ($ 75 per 4-oz bottle, $ 75 per can special developer) Direct color toning developer for prints, created by Anton Bruehl, well-known American photographer Permits development of print to a colored image in any one of six colors Variations of obtainable colors endless, is manufacturer's claim, "de-

pending only on the ingenuity of the photographer." Available colors: three basic and three additional from which various combinations may be produced Colors are red, yellow, blue, sepia, sea green, snow blue.

SAYMON-BROWN RANGE FINDER ($15, including installation) Couples directly to lens standard of Speed Graphic, Bee Bee, Linhof, Ihagee, Recomar, Jewel, and similar cameras, as well as many postcard-size roll-film cameras Design correct optical balance of mirrors, which are made tarnish-proof and permanent by same process used for observatory telescope mirrors, provides brilliant illumination of images even in adverse light or at night Center object of amber color to make quick, accurate matching of images for all distances from 3 feet to infinity Finder measures 3⅛ by ⅝ by ¾ inches, weighs 2½ ounces Finished in satin chrome Guaranteed by makers Installation can be made through regular dealer

SPEEDGUNS DELUXE "C" JR AND "C" DELUXE, for Miniature Speed Graphic and larger Speed Graphics, feature completely open bulb clamp, with positive ejector Head of gun redesigned for proof against rain Battery case fastened to camera by means of new bracket Flip of thumb tightens case against improved clip "Shake it up or down, back or forth—you can't budge it," declare the makers Flip thumb again and case is free Other features include positive switch button and safety switch button guard

HAYNES SHUTTER CHECKER (50 cents) For testing accuracy of between-the-lens shutter Used with any phonograph turntable Stroboscopic ring assures correct rate of turn No calculations required for speeds from one-half second to 1/500th

16MM FILMO TITLER For use with all Filmo 16mm cameras Features "visual centering" arrangement permitting titles to be centered accurately through viewfinder of camera Titler consists of camera carriage, title-card carriage, two swiveled reflectors, each unit sliding upon connecting track and clamping firmly in any position. Title can be used horizontally or vertically, as an animation stand or to permit filming title actually being written by human hand Reflectors adjustable and made to take No 1 Photofloods

AGFA MEMO WITH LENS F/5 6 ($14 50) Memar f/5 6 anastigmat focuses from 3½ feet to infinity Shutter speeds 1/25, 1/50, and 1/100 of a second, plus Time and Bulb. Compact, steel construction Provides Memo-type rapid film transport mechanism Loads with standard Agfa Memo cartridge, 24 double-frame size pictures (1-7/16 by 15/16ths inches) per cartridge Other features include brilliant, optical, di-

rect view finder, tripod socket, cable release socket, neck-cord eyelets, automatic exposure counter Accessories available leather eveready carrying case, filters—yellow, red, and green, sunshade, neckcord, cable release, tripod

PHOTO-ART DODGER (75 cents) Contains number of apertures of various sizes and shapes which can be further modified by rear plate into many series of patterns. Useful for localized spots, special effects, vignetting Diameter of dodger 1¼ inches Complete instructions printed on upper surface of dodger

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THE ROUND TABLE

Questions Answered for the Amateur Photographer

Q **What characteristics are lost when an anastigmat lens is "stopped down" I know that the depth of field is increased Does the lens lose anything if focusing is accomplished by moving the front part of the lens while the back element remains fixed?—E J T.**

A Stopping down may cause a softening, that is, slight off-sharpness of the image, as compared with the image when focused at a larger opening, but this is usually of no practical consequence Besides, the advantage of depth of field, where this is required, far offsets the above disadvantage Opinion varies concerning the advisability of the method employed on some lens mounts by which the front element is moved back and forth in focusing while the back element remains unmoved One of the best known cameras of today enjoys a wide popularity both among advanced amateurs and professionals, who usually are very exacting, despite the fact that it employs this method of focusing

Q. **In using an exposure meter it is recommended that it be held near the object. Since the intensity of light varies inversely as the square of the distance I have not been able to figure out why a foot candle reading close to the object is just as applicable in calculating exposure time, and stops, when using the camera close up as it is when using it at several feet distance. Just why is there no distinction made?—G. O. L.**

A The "square of the distance" which you mention has reference to the distance between the subject and the source of illumination and not the distance between subject and camera. Therefore, provided the light remains the same distance from the subject, it would not matter how near or how far you held the meter from the subject were it not for this important factor an exposure meter covers a wider angle of view the farther it is held from the subject, with the consequence that the resulting reading takes in not only the light reflected from the subject but also that reflected from the surrounding area If the meter's angle of view could be cut down so narrowly that, even at the position of the camera, only the light reflected from the subject would be included, there would be no necessity for approaching the subject closely, and the reading would be the same, whether held close up or at the camera position

Q. **Please state if the old type Petzval lens is achromatic. I want to use this lens for a terrestrial telescope even though the focal length is 24 inches.—A. T.**

A The Petzval lens is semi-achromatic, not fully corrected for color aberration, but sufficiently so for the purpose you have in mind

Q **I have been advised to use a Polaroid filter to eliminate reflection I notice that when the filter is turned in the housing, the field darkens and appears to have a purplish cast. Will this affect the natural colors on Kodachrome Type A film? Also, how effective is the filter for the purpose, and what changes in exposure time will be required?—S A R.**

A The darkening of the field is caused by a reduction in the amount of light admitted, and will not affect the color rendering of Kodachrome The effectiveness of the Polaroid filter in eliminating glare and reflection has been proved by many workers who have used this screen, as it is more properly called, both with Kodachrome and regular black and white film Because the light is cut down, the exposure time should be twice that required without the screen

Q **Is there any type of successive flash equipment that would enable me to get several shots of wild life in the woods after dark within about 15 to 30 seconds?—G. W. T**

A By operating very quickly, you could probably get a few shots within this period with regular flash equipment and provided the camera film advance is of the automatic type If your flashgun head is of the bulb ejector type, speed would be facilitated There is soon to appear on the market a multiple flash gun taking as many as a dozen G E No 5 "Midget" bulbs, which may be fired successively one after the other in synchronization with successive films This will probably be most useful for your purpose

Q **Can you furnish information on home development of movie color film?—R. S. M.**

A The only motion picture color film that may be processed at home is Dufaycolor Details may be obtained by writing to the manufacturers, Dufaycolor Co, Inc, 68 West 48th St, New York City A drum recently placed on the market called the Graphic Reel can be used for processing It has a capacity of 32 feet of 16mm or double 8mm film

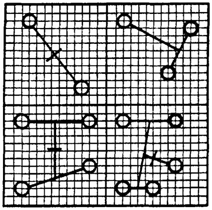
Conducted by A. D. RATHBONE, IV

INTEREST IN FIREARMS *is traditional with American men, fishing tackle is a requisite of one of the world's oldest occupations. Scientific development of guns and tackle, in the use of which millions yearly find sport and recreation, fathers this monthly department which welcomes correspondence from readers*

Center of Impact

IN the belief that many shooters have wished for a simple, easy formula for locating exactly the average point of strike, or "center of impact," of a group of shots when targeting a rifle or pistol in sight alignment, Walter T Gorton, of the Springfield Armory, Springfield, Massachusetts, sent us a suggestion accompanied by drawings. Mr Gorton has so ably expounded his idea that we'll let him tell it in his own way, with our sincere thanks for his interesting contribution.

"It is not difficult," writes Mr Gorton "to determine the location of the



Upper left, Figure 1. Upper right, Figure 2. Lower left, Figure 3. Lower right, Figure 4

center of impact by averaging the horizontal and vertical locations of a group of shots by measuring from suitable vertical and horizontal reference lines, such as the edges of the usual paper target, but this process is rather slow and inconvenient. Since a single shot is not conclusive for targeting purposes, a group of shots is necessary, and the smallest group, of course, is two, which, while more conclusive than a single shot, is still rather small. The center of impact of a two-shot group is very easily found, as obviously it lies exactly half way between the two. (Figure 1)

"This principle is easily and conveniently applied to larger groups. Three shots form the smallest group which is reasonably satisfactory for targeting purposes. To get the center of impact of such a group, first find the mid-point of the line joining any two shots. The center of impact for the group lies one third of the way along the straight line from this point toward the third shot. (Figure 2). Three-shot groups will do fairly well, but four-shot groups are better and can be measured quite as readily. Simply join any pair of shots with a straight line, and the remaining pair likewise. The mid-point of the straight line joining the mid-points of these two lines is the center of impact of the group. (Figure 3.)

"The orthodox five shot group also can be measured very easily, so the shooter who must have a group of this size can fire his five rounds cheerfully, letting them fall where they will. To measure the group, first locate the center of impact of any four shots as above described. One fifth of the way along the straight line from this point toward the fifth shot is the center of impact for the whole group (Figure 4), and this method can be applied to groups of any size, by working in successive steps. A geometric principle, the process boils down to this. Consider the individual shots to be small bodies of equal weight lying in the plane of the target. The center of impact of the group is the center of gravity of this system of like bodies. Figures have been drawn on coordinate paper so that skeptics may readily verify the plotted location of the center of impact in each case by finding the average horizontal and vertical locations of the various shots. A graphic check, also, may be made in all but Figure 1 by starting with other pairs of shots."

Back-Woods Are Closer

IF it were not for technological progress in the realm of marine motors, a lot of us who like to angle for the big ones back in the wild country might find ourselves handicapped in fulfilling our piscatorial desires. True, the ancient and honorable method of canoe travel is still to be relied upon and is particularly applicable to the fisherman whose budget is more limited than is his time. The airplane is our modern way of getting into the bush, but it does reverse the aforementioned budget-time premise. Due to scientific advances in outboard motor manufacture, however, we now have a middle-of-the-road method which saves time, costs next to nothing and is as reliable as the powerful motors which wing over forest and lake. Today we can answer "the call of the wild" just as we always have by stowing our duffle into the old canoe. But, by adding only a relatively few pounds to the total weight of our outfit, we can save lame

muscles, blistered hands and many hours—in which to get in more fishing Here's how it's done

Let's assume we're headed for the Lake of the Woods sections, or northwestern Quebec, where chains of lakes connected by small streams or short portages will lead to the lair of the muskie, the wall-eye, or the great northern If we take along an Elto Cub outboard motor, for example, made by Evinrude Motors, we add only 8½ pounds to our load A special

With an 8½-pound outboard motor and a few gallons of fuel, the hunter or fisherman can save much back-breaking work

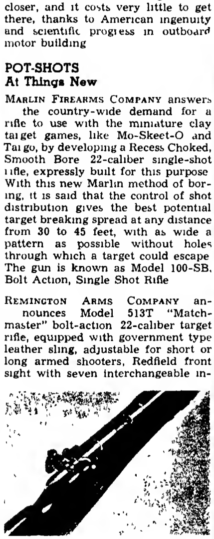
bracket for canoe attachment is a couple of pounds more and packs easily The motor runs 10 hours on a single gallon of fuel, will propel two men and their duffle in a canoe up to five miles an hour As a conservative figure let's say we average 3½ miles per hour on lake travel, which comes to 35 miles for our first gallon of gasoline consumption and is probably a greater distance than a couple of city-softened outdoorsmen can hope to cover by paddle on the first day out Without straining our backs too much we can pack in four extra 1-gallon tins of pre-mixed motor fuel, a total weight at the start of about 32 pounds, and we are assured of a minimum of 175 miles of motorized canoe travel Based on our own experience of many thousand miles in a canoe, upstream and down, with the wind and against it, we believe a 25-mile-a-day average by paddle is about all two soft-muscled men can hope to accomplish If we cover the same distance by motor in five days, instead of the seven required by paddle, we'll have two days more in camp, and it has cost us a little over $25 for the motor and about two cents an hour for its operation

As noted above, the modern outboard motor is a far cry from its early ancestors in power, dependability, and weight. With Evinrude motors, for instance, the "dynamometer test" is used to establish power ratings. To insure absolutely impartial results, Evinrude has all models tested by The Pittsburgh Testing Laboratories, whose results are submitted to The National Outboard Association for final certification before being used by the manufacturer Dependability and further protection are afforded through a policy of measuring horsepower at engine speeds recommended for constant service, rather than peak horsepower attainable, thereby assuring long hours of continuous and uninterrupted operation As to weight, anyone who used to strain his back in order to install an outboard of 20 years ago will recognize the portability and adaptability to fishing trip usage of an 8½-pound motor which develops 5 N O A Certified Brake H P at 4000 R P M Yes, in these days the back-woods and the big fish are closer, and it costs very little to get there, thanks to American ingenuity and scientific progress in outboard motor building

POT-SHOTS At Things New

MARLIN FIREARMS COMPANY answers the country-wide demand for a rifle to use with the miniature clay target games, like Mo-Skeet-O and Targo, by developing a Recess Choked, Smooth Bore 22-caliber single-shot rifle, expressly built for this purpose With this new Marlin method of boring, it is said that the control of shot distribution gives the best potential target breaking spread at any distance from 30 to 45 feet, with as wide a pattern as possible without holes through which a target could escape The gun is known as Model 100-SB, Bolt Action, Single Shot Rifle

REMINGTON ARMS COMPANY announces Model 513T "Matchmaster" bolt-action 22-caliber target rifle, equipped with government type leather sling, adjustable for short or long armed shooters, Redfield front sight with seven interchangeable in-



"Matchmaker" comes complete

serts; Redfield No 75 micrometer rear sight with ¼-minute adjustments, special target stock and pistol grip of dark finished American walnut with high, thick comb and long, wide beavertail fore-end, 27-inch, heavy, semi-floating barrel, double countersunk at muzzle, bored and rifled for extreme accuracy "Matchmaster" has anti-backlash trigger stop for crisp, smooth trigger pull, short, fast, firing-pin travel, corrugated trigger, double

locking lugs on bolt and double extractors, firing indicator and positive side lever type safety Butt plate is sharply checkered, front sling swivel is adjustable to arm length and barrel is drilled and tapped for scope blocks, with plug screws in holes Detachable magazine box holds six cartridges and rifle is chambered for 22-caliber long-rifle cartridge Over-all length of gun is 45 inches, taken-down length, 33 inches. Moderately priced, the "Matchmaster" is ideal for four-position shooting

MOHAWK PRODUCTS, makers of that unique and rather revolutionary "Peep-Scope" we recently told you about, announces a reduction in price from $5 00 to $4 25 It seems the "Peep-Scope," which, through its one-inch length provides a telescopic effect by use of precision ground lenses, has met with such cordial reception from riflemen that increased sales and wider distribution brought about the lower price

AMERICAN OPTICAL COMPANY presents scientifically designed, streamlined shooting glasses fitted with special Calobar or Noviol lenses to cover all conditions for hunters, marksmen, trap and skeet shooters For all 'round

eye protection, good visibility, particularly in bright sun, Calobar lenses are recommended as reducing glare, absorbing the tiring, invisible infra-red and ultra-violet rays which cause eye strain and fatigue Noviol lenses are counseled to obtain sharper detail on dull, hazy days and both types can be ground to prescription for defective eyes

O F MOSSBERG & SONS, INC , have a low-cost spotting 'scope to keep company with those fine new rifles we told you about last month Their 20-power Model A "Spotshot" 'scope is light, sturdy, has achromatic objective lens 38mm in diameter, ground to 00001 of an inch, and is equipped with metal eye caps for both ends Eye-piece lens is 10mm with micrometer focus adjustment In black crinkie finish with chrome plated draw tube, it is 17 inches long extended, 12½ inches when closed, weighs 1½ pounds, and has field of approximately 7½ feet at 100 yards A 2¼-pound folding aluminum alloy and steel stand offers rigid support, has screws for adjustments

THE PARKER-WHELEN COMPANY, INC , formerly National Target & Supply Company, in presenting its 5th edition of Colonel Townsend Whelen's "Gun Handbook and Catalog," offers to the shooting fraternity one of the most comprehensive and authoritative volumes on firearms we have ever seen Colonel Whelen, who needs no introduction to American shooters, had as his editorial associates three men whose names have long been synonomous with expert knowledge of guns and ammunition, namely, Colonel Julian S Hatcher, Colonel H P Sheldon, and Major Charles Askins Each has contributed a fund of factual information from the fields in which he is a nationally known authority Colonel Whelen wrote the sections devoted to Small Bore Rifles, Game Rifles, Telescope Sights for Rifles, Pistol Marksmanship, Colonel Hatcher has exhaustively handled Revolvers and Pistols, Colonel Sheldon and Major Askins covered the shotgun field and marksmanship with the scatterload There are also articles on cleaning and cleaning materials, receiver sights and binoculars, reloading tools, clothing and outdoor equipment, gunsmithing, and a particularly helpful article entitled, "Useful Information for Shooters" The book is profusely illustrated, includes prices of all equipment shown and sells for only 25 cents a copy

SHAKESPEARE COMPANY, which for many year has been supplying innumerable anglers with "what it takes" to take the fish, offers an exceptionally fine 1940 catalog If you haven't obtained yours, we suggest you do so before the fishin' season is a minute older, and then devote a pleasant hour or so to its perusal You'll find it enticing, helpful, constructive, and educational, particularly the pages depicting methods used by Tony Acetta, U S Amateur Bait and Fly Casting Champion, who really "gets 'em"

THE TANGLEFOOT COMPANY offers welcome relief from mosquitoes and other pests to both angler and hunter through use of its new repellent A safe, greaseless, non-irritating cream in generous size tube, Tanglefoot MosQUITo Repellent has added virtues of actually being fragrant, lasting, and harmless to the most delicate skin

BILL DEWITT BAITS offers deep-sea anglers absolute freedom from rust or salt corrosion of hooks through use in their manufacturing process of "Z" nickel, a heat-treatable alloy of approximately 98 percent nickel (See May, 1940, Scientific American, page 277). Clean barbs, toughness, springiness, and great tensile strength are all provided at low original cost, which, due to rust-free properties, is likewise last cost From E S Russell, of Bill DeWitt Baits, came samples of hooks with invitation to immerse one in strong salt solution. We did Together with an ordinary hook, it stayed immersed 18 days, came out absolutely clean, fresh, shiny You should have seen the other hook!

Our Book Corner

THE BOOK DEPARTMENT of Scientific American is conducted, with the co-operation of the Editors, to make available for you a comprehensive book service Each month the Editors select and review in these columns new books in a wide range of scientific and technical fields. In addition, they are ready at all times to advise you regarding the best available books on any subject. You are invited to use this service freely Tell our Book Department what kind of books you want and you will be furnished with a list of available titles, including prices. When inquiring about books, please be specific: remember that we can be of the greatest help only when you tell us just what you are looking for.

WE PRESENT TELEVISION

Edited by John Porterfield and Kay Reynolds

PRODUCED in an endeavor to give the non-technical reader a complete survey of the television situation, this book presents a running story, beginning with the technique of television and carrying through studio operation, programs and direction, acting, and the financial problems The text has been prepared by a group of specialists who are in direct contact with those phases of the work about which they write (298 pages including a glossary of terms, 6 by 9 inches, illustrated with photographs and drawings)—$3 10 postpaid —*A P P*

AMERICAN AVIATION DIRECTORY

IN the early days of aviation, the industry was so small that everyone in it knew everyone else Now, aviation has grown to such immense proportions that it is impossible for any one person to keep track of organizations, companies, and personalities The American Aviation Directory will, therefore render a very valuable service and has been received with enthusiasm The Directory is in a carefully classified form, covering aircraft manufacturers and their personnel, air lines and their personnel, accessory firms, schools, trade organizations, state and federal organizations, and so on A useful alphabetical index is provided Loose-leaf form — Yearly Subscription, $5 00 —*A K*

LIVING LIGHT

By E Newton Harvey, Professor of Physiology at Princeton University

THERE is a very great deal of scientific information in this book, which is divided into six sections, respectively on cold light, light-producing organisms, types of luminescence, chemistry of light production, physiology of light production, and the physical nature of animal light Under each section the appropriate subject is developed in a full sweep of detail A reader who had extracted from this book its whole content would know a great deal about cold light in all its aspects—physical, chemical, physiological, and even engineering It is not a textbook but in its seriousness it comes nearer one than anything resembling a popularization, yet the language is as simple as possible No such book, bringing all scattered data within a single pair of covers, has appeared in English in many years, nor is likely to appear in many more The author, known the world over, is the foremost scientific authority on the subject, which he has pursued as a specialty in the field and laboratory for a quarter century (328 pages, 6 by 9 inches, 80 illustrations)—$4 10 postpaid —*A G I*

PHOTOGRAPHY, PROFESSION, ADJUNCT, RECREATION

Addresses by 24 speakers

DESIGNED to lay before the girl graduate the opportunities for work available in the various photographic fields, a Conference on Photography, Profession, Adjunct, Recreation, was held in New York under the auspices of the Institute of Women's Professional Relations, Connecticut College, New London, Connecticut During the course of that conference, which was helpful to all young people without regard to sex, 24 speakers discussed almost as many photographic fields Their addresses were compiled and published in the present work Those seeking advice on how to make a "go" of photography should find considerable guidance whether one desires to make a profession of photography or to use it in conjunction with some other vocation (Mimeographed, 135 pages)—$1 60 postpaid —*J D*

THE WESTERN ANGLER

By Roderick L Haig-Brown

HERE are two of the finest volumes ever released on the lore, technique, and fascination of angling, and the public necessity for its continuance as a sport The author's vast ichthyological knowledge enables him authentically to present the history, habits, and scientific development of native and imported British Columbia trout and salmon, to describe their diseases, their enemies and their propagative possibilities from first-hand information There are a complete index and two appendices, the latter covering respectively British Columbia fly dressings and a formula for determining fish population of lakes. Printed on deckle-edged paper, with nine magnificent color plates of trout, salmon and flies and numerous other halftone illustrations in sepia, these beautifully bound volumes are one of the best buys to reach the mar-

ket in a long time. The edition is limited to 950 numbered copies. (Two volumes totaling 391 pages, 8½ by 11 inches.)—$25.10 postpaid.—*A. D. R., IV.*

AERONAUTICAL DICTIONARY AND REFERENCE LIBRARY

By R. Hartley, Jr.

Mr. Hartley is a man of considerable experience in the production aspects of aircraft and as a teacher of practical aviation subjects. The terminology of aeronautics is constantly growing and outside of a short "Nomenclature for Aeronautics," published by the N.A.C.A., there is no English publication dealing with the terminology of this great new industry. Mr. Hartley's work will meet, therefore, a well defined need and will certainly be a help to students, mechanics, pilots, and many others. The 524 pages of the Aeronautical Dictionary are clearly printed and well arranged. Part I covers definitions, nomenclature, terminology, and phraseology. Part II, entitled "References," gives condensed but useful information on aviation engines and aluminum alloys. It also gives a brief chronological history of aviation.—$4.10 postpaid.—*A. K.*

SEX IN MARRIAGE

By Ernest R. Groves, Prof. Sociology, University of North Carolina, and Gladys Hoagland Groves

For the newly married, those about to be married, and those having marital difficulty because of sex adjustment. This book is neither very technical on the one hand nor shallow and superficial on the other, but seems to be aimed about at average people. It contains a good deal of good and sound information. (250 pages, 4¾ by 7½ inches, unillustrated.)—$2.10 postpaid.—*S. S. J.*

INTERIOR ELECTRIC WIRING AND ESTIMATING

By Albert Uhl, Arthur L. Nelson, and Carl L. Dunlap

The latest principles of wiring for homes, apartment buildings, and factories, including permissible wire sizes, devices, conduits, and the like. Numerous illustrations show the manner in which wires or conduits are installed in any kind of building structure. The section on estimating is especially complete and forms are given to show an actual job of estimating. (342 pages, 5¾ by 8½ inches, numerous illustrations.)—$2.60 postpaid.—*F. D. M.*

THE SOUL OF THE UNIVERSE

By Gustaf Stromberg

An attempt to erect a ladder between the worlds of physics and biology and a World Soul or God. Mainly the book discusses the former and, separate from the soul thesis which is to follow near the end, it is a competent,

lucid exposition of space, time, matter, and of gravitational and electric fields, also of heredity and genes and theories of the origin and development of life on earth These lead to a discussion of mechanism, vitalism, and religion, all three of which the author considers valid, and thence through the development of the human mind or soul to a world soul This book will appeal especially to those interested in science and religion and in the linkage that is built up between the two The conclusions that the author, a member of the research staff of Mount Wilson Observatory, has reached through his study of the laws of the universe, make the book unusually interesting and worthwhile (244 pages, 5¼ by 8 inches three illustrations)—$2 10 postpaid —*A G I*

REFINING PRECIOUS METAL WASTES

By C M Hoke

BASED on 24 years of experience in teaching jewelers, dentists, and small refiners how to refine their precious metal wastes, this book bears heavily on the practical Gold, platinum, silver, alloys, iridium, rhodium, low grade wastes, equipment, processes, identifying, the stock pot, repurification, equipment, dealer list—these items selected from here and there in it give the scope of this useful treatise (362 pages, 6 by 9 inches, illustrated)—$5 10 postpaid —*A G I*

THE ROAD TO MODERN SCIENCE

By H A Reason, B Sc

HISTORIES often are regarded as dull but this is the story, not the history, of science from the crudest beginnings straight through to our own times It is not, however, a fluffy kind of account but one containing much substance even though written in popular, readable style (297 pages, 5½ by 8 inches, 76 illustrations)—$3 10 postpaid —*A. G I*

THE GUN COLLECTOR'S HANDBOOK OF VALUES

By Charles Edward Chapel

OF inestimable value to gun collectors, both amateur and professional, is this newest publication by the author of "Gun Collecting" (Reviewed in our issue of January, 1940) This is the first comprehensive effort in the English language to catalog and evaluate firearms for the collector, to say it is successful is to put it mildly Some 2000 antique and semi-modern pieces, over 500 of which are illustrated, are described in detail, and values for "good" and "fine" condition have been assigned For those who collect old guns, or for those who would like to collect them, this publication is absolutely indispensable (220 pages 4¾ by 7½ inches, 33 full page plates.)—$3 10 clothbound and autographed, postpaid; $2 10 paperbound, postpaid.—*A D R., IV.*

A Monthly Department for the Amateur Telescope Maker

Conducted by ALBERT G. INGALLS

THING of first importance in a telescope is functional excellence, of course, but it is, however, nearly always possible, without compromising this quality, to combine attractiveness By attractiveness some may mean decorativeness This may have its place provided it does not run to over-decorativeness and to "gingerbread" Perhaps, however, the best source of that something which gives beholders an instinctive feeling of satisfaction in any machine or structure is good proportion of parts and of the whole

Figure 1: Hopkins' pleasing design

It is a long time since this department has received photographs of so well proportioned a telescope, whether made by amateur or professional, as the one shown in Figure 1 This 6" reflector was made by Edward Hopkins, 431 Fulton St, Elizabeth, N J, who, according to our advices, is in charge of a machining department in one of the big airplane manufactories

"The knowledge required to build this telescope," Hopkins writes, "came entirely from the Scientific American books 'Amateur Telescope Making' and 'Amateur Telescope Making—Advanced' Its base was made from an old traffic sign, to which three leveling screws were added The pedestal was converted from a truck torque tube This was cut in two, and two flanges were welded on and machined, to permit the top section to be rotated slightly in order to line up the telescope

"Atop the pedestal, the axle housing, from a Nash car, is slantingly welded on The R A shaft turns on tapered roller bearings and is drilled through, so that Polaris can be sighted through a ring welded on the declination shaft The declination shaft also turns on roller bearings mounted in a Model A Ford axle housing

"The R A setting circle is graduated to units of 10' and has a vernier to read to 1', the declination circle to 1°, with vernier to 5'

"The Bakelite tube can be turned in a split sleeve and is guided by two brass rings that were not yet on when the photograph was made The mirror is Pyrex, of 48" *f l*, and is supported in the cell by a split brass ring with a cork insert It is held by six screws around the edge, and behind by a triangular plate with three cork pads The prism holder is universally adjustable

"Accuracy in the working parts was held to a very high degree, the limits held as close as possible with precision measuring instruments

"The whole thing handles easily and can be carried by a delicate woman, with the help of a strong man"

Not every amateur has access to fine machine tools or has had a chance to learn their use Yet good proportion does not require these things, in fact, some who have them do not attain to it Take, for example, the counterweights of this telescope, even though this is not a very vital part If we were to make these only a few percent fatter and stubbier, or else skinnier and longer, the telescope would seem to one judge, at least, to have lost its fine figure, just as your scribe has Maybe Hopkins just happened to have metal of these proportions but our guess is that he planned it so, as he did with other details

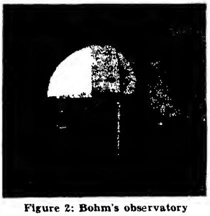


Figure 2: Bohm's observatory

STONE is the chief material from which Anton Bohm, a monument maker, Apex Monument Works, 6815 W 29th Avenue, Edgewater, Colorado, built his observatory (Figure 2) Its granite, brick, and stucco-lined wall is 12" thick and 8' feet high (including the 2' part that is hidden) The outside diameter is 12½' Inside are three stone steps rising 24" to the concrete floor, with a trap door to cover the stair well, thus forestalling broken necks In front is a low surrounding wall to contain earth for Mrs Bohm's flowers and vines Bohm says Mrs Bohm helped him with the observatory by mixing concrete The telescope pier goes 8' below the surface Absolutely no vibration is noticeable

The dome is framed with 25/32" lumber and covered with 3/16" building board oiled three times inside and outside with linseed oil To this, heavy canvas strips were added over the joints and the entire surface was given three coats of white outside paint The shutters (Figure 3) are self-explanatory, also satisfactory The acoustics inside the dome is fine, especially for people with squeeky voices, Bohm states

A lead cable from the residence conducts current for light and drive A temporary telescope is in use while Bohm patiently proceeds with a 12" reflector whose tube is shown in Figure 4 Each of the eight main struts of aluminum was cast in one piece from patterns previously made and used by Carroll C Spencer, of the Spencer Laboratories, Denver "Don't think the foundryman didn't cuss when casting the pattern eight times," Bohm writes "He had to lie awake nights to figure out a way to prepare the mold so that the castings with about ¾" shrinkage, would not break as they cooled" To clean up these castings, Bohm filed 15 hours on each strut! The rings are 14" brake drums from old Essex cars The profile of the tube gives a feeling of nice proportion—or have we gone entirely mad on proportion?

Figure 3: Petal type shutters

In describing the Goethe Link Observatory, at Brooklyn, Ind, in the June number, Victor E Maier, Director of the Observatory, mentioned that the Hartmann test of the 36" mirror was reduced by Dr James Cuffy of Indiana University. Dr Cuffy writes that, after becoming thoroughly conversant with everything in "ATM" and "ATMA," he was sur-

Figure 4: The leg-shaped tube

prised to find that amateurs had almost no appreciation of the value of the Hartmann method of testing He thinks this may have resulted from the brevity of the chapter on this test in "ATMA," so he wrote up the method as he used it, including shortcuts which he says simplify it enormously His account, which ought to be in "ATMA," follows

"The Hartmann method of testing optical surfaces has, apparently, been avoided almost entirely by the amateur astronomer The avoidance may be due largely to the photographic technique involved, but also, I believe, to the implication ('ATMA,' page 109) that the Hartmann test is one applied to finished mirrors alone Possibly the following paragraphs will serve to point out its value in testing a mirror at any stage of the figuring process

"The advantages of the Hartmann method are 1 Its complete objectivity, there is no judging of equal brightnesses for patches of light separated by considerable distances The measurement of a radius of curvature is reduced to the measurement of a distance on a photographic plate 2 The greater number of zones that may be tested at one time To test numerous zones visually requires time, and fatigues the eye, whereas the Hartmann test gives the radii of as many zones as desired with a minimum of effort 3 The more detailed knowledge of the deviations of the surface from parabolic, or other required surface, that results from testing many zones of the mirror

"The disadvantages, as seen by the uninitiated, are the need for large numbers of photographic plates, especially since, in its conventional form, each test requires two plates, and the need for a comparator in measuring the plates These objections, however, may easily be met I am confident that, once the amateur has tried the Hartman test, he will be convinced of its superiority over visual zonal testing

"In Hartmann testing, we place a perforated diaphragm before the mirror The perforations are customarily placed along eight different axes of the mirror The diameters of the holes are usually 1/400 of the distance from diaphragm to plate, and the centers of the holes are separated by approximately 2½ times the diameter of each hole Naturally, it is only when testing for astigmatism that one measures all the axes of the mirror The geometry of the test is shown in Figure 5 We are interested in obtaining the distances, d_1, from the plane of the photographic plate of the points where the rays from a given zone cross the optical axis

"The first simplification we may make (see Danjon et Couder, 'Lunettes et Télescopes,' p 507) is to dispense with one of the plates, and to substitute for it the diaphragm itself (at s_2) Since we have constructed the diaphragm with reasonable accuracy, we know immediately the values of a_2, or the separations of the two holes corresponding to the given zone d_2 is then the distance of the diaphragm from the pinhole, or, with sufficient accuracy, the radius of curvature of the mirror Thus, it is sufficient to take only one plate, inside focus, and to compute once and for all the factors d_2/a_2 by which the separations on the photographic plate, a_1, must be multiplied to give the distance from the plate to the intersections of the rays with the optical axis

"The second simplification lies in the method of measuring the plates Since the Hartmann pattern is usually only ½" in diameter, we may use an ordinary photographic enlarger to enlarge the particular row of spots in the pattern to be measured up to about 10" long (strips of bromide paper 1" wide are sufficient) We then measure the positions of the spots with a good ruler The scale of the enlargement must be known, and a simple method of determining the enlargement factor is to place a small piece of scotch tape of known width on the emulsion of the plate near the row of spots to be measured We may then divide the separations measured with the ruler by the enlargement factor, in order to obtain the desired values of the a's on the plate

"One could, of course, avoid photographic work entirely in making a Hartmann test by providing himself with an eyepiece micrometer having illuminated cross-wires, thus making settings of the cross-wires on the image of the Hartmann pattern directly without bothering to photograph it

"It is important that the Hartmann diaphragm be held in a plane as close to the mirror as possible, and that the plate be perpendicular to the optical axis If the mirror is of high aperture ratio ($f/4$ or less), the value of r for the zone being tested will differ slightly from the value of r measured on the screen, because of the inclination of the rays and the fact that the diaphragm is not in contact with the concave surface. Ordinarily, however, we may use r as measured on the diaphragm for computing the parabolic radii, r^2/R

"The writer has used the Hartmann test as described above in testing the 36", $f/5$ mirror for Dr Goethe Link's observatory (Brooklyn, Indiana), and has found the method convenient and accurate He had, however, access to a good measuring machine

"Having obtained the values of the radii for a number of zones of a mirror, we may compare them with the computed values for a perfect mirror and predict the performance of the mirror in actual use Thus, we may compute

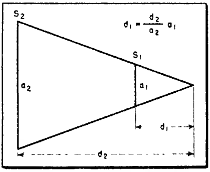


Figure 5 Geometry, Hartmann

the value of the Hartmann criterion, t, which is the weighted mean radius of the confusion disk, each zone of the mirror being weighted according to its light gathering power, or its circumference, since the area of any zone is proportional to its circumference The value of t is given by

$$t = \frac{200{,}000}{F} \cdot \frac{\Sigma r \Delta F}{\Sigma r}$$

where 200,000 is very nearly the number of seconds of arc in a radian, F is the mean focal length, r is the distance of the zone from the optical axis, and Δ F is the axial error from true focus All the Δ F's are taken as positive numbers, that is, we use their absolute rather than their algebraic values If a mirror is to perform well, its Hartmann criterion must be less than its theoretical resolving power, or 4 5 seconds/aperture (inches)

"Most of the large mirrors at present in use have values of t between 0 1 and 0 2 A mirror larger than 24" in aperture, and having a value of t less than 0 5, is just satisfactory for photographic work, but unsatisfactory for visual work In fact, seeing conditions combine with photographic graininess and the diffusion of light in the emulsion itself to make star images less than 0 035 mm in diameter rare, while under ordinary conditions the images obtained with a large instrument are usually between 0 05 and 0 10 mm. in diameter. It is thus evident that the demands for high optical quality are about five times as stringent in the case of a telescope to be used for visual work as for one intended primarily for photography. And therein lies the reason why the average astronomer is able to obtain plates of value on

nearly every clear night. The situation is perhaps best described by saying that seeing conditions are seldom too bad for photographic work, while they are seldom good enough for visual work, at least with high powered eyepieces."

WE keep hearing of more and more men who once were ordinary amateur telescope makers and who sweated over their first 6" mirrors, "even as you and I," now finding their permanent life work in optics as the ultimate outcome Ralph Dietz is with the Mt Wilson shops, two amateurs now are pros with Bausch and Lomb, while around New York are several who are regularly employed in professional shops What is called the "Optical Division" of the American Astronomical Association is that fraction of The New York City amateur astronomers who enjoy getting their rougey hands on hunks of glass and converting them into telescopes and other things optical Its organizer was Lew Lojas, and he, for the past three years or so, has earned his living as an employed professional He is with the Kollmorgen Optical Co, 767 Wyeth Ave, Brooklyn, N Y, where he polishes and corrects lenses Edward Hanna, another Optical Division amateur, now is also with Kollmorgen, edging and inspecting lenses, while Walter Howland, from the same amateur group, is a Kollmorgen computer

Working in the Jersey City shops of the Perkin-Elmer Corporation, of 90 Broad St, New York, N Y, is Daniel E. McGuire, a typical amateur from a typical Ohio small town who went to the great city and who is running the polishers and correcting objectives, also Stanley Brower, who does blocking and works on magnifiers, eye lenses and microscope objectives. We hear there is an opening for one more good man in these shops

In Keuffel and Esser's shops, at 300 Adams St, Hoboken, N J, is another optical Division man, Carl Grosswendt, doing optical inspection

Some of these men and others who may choose similar work stand a good chance of becoming leaders in the optical industry in later years

We have received a letter from Frank A Eaton, of the Bausch and Lomb Optical Co, Rochester, N Y, who mentions the comments about war emergency optical jobs for amateur telescope makers, made here last month, and says "We are interested in knowing sources from which applicants may be obtained in the future While it is not our intention to encourage more people to come to the plant for interview at this time, since the numbers now applying far exceed any future employment we shall have for them, if the amateur telescope makers will merely write to us, so that we have their names and addresses on record, with an explanation of what they have done with optical grinding and polishing, that will be sufficient material for us to use in seeking later interviews"

Patent, Trade Mark, and Related Legal Proceedings That May Have a Direct Effect on Your Business

By ORSON D. MUNN, Litt.B., L.L.B., Sc.D.

New York Bar
Editor, Scientific American

Notice

A PATENTEE who does not manufacture and sell the patented article may recover profits and damages from an infringer even prior to the time that actual notice of infringement is transmitted to the infringer

Much confusion has been caused by the provision of the statute which states that it shall be the duty of all patentees making or vending a patented article to affix thereto the required patent notice consisting of the word "Patent" followed by the number of the patent The statute provides further that "in any suit for infringement, by the party failing so to mark, no damages shall be recovered by the plaintiff, except on proof that the defendant was duly notified of the infringement, and continued, after such notice, to make, use, or vend the article so patented "

It will be readily understood that where a patentee manufactures and sells articles under his patent he must affix the proper patent notice to the article in order to recover profits or damages from the infringer Should he fail to affix the notice to the patented article he can only recover profits and damages accruing after the date on which notice was transmitted Confusion has existed, however, as to those instances where the patentee did not manufacture and sell the patented article Some courts were of the opinion that profits and damages could only be recovered after the date on which actual notice was transmitted, while other courts expressed the opinion that no notice was necessary

This confusion was dispelled by a decision of the United States Supreme Court which, after reviewing the history of the statute, concluded that it was only intended to apply to those instances where the patentee manufactured and sold articles under the patent Where no manufacture and sale took place the patentee could recover damages and profits, the Court held, even though no notice of infringement was transmitted to the infringer

Early American

WHEN an application for the registration of a trade mark is approved and passed by the Patent Office it is published in the *Official Gazette* prior to the registration of the mark Anyone believing that he would be damaged by the registration of the mark may, within 30 days of the date of publication, file a notice of opposition to the registration When the opposition is based upon a prior trade mark owned by the opposer and the opposer charges that there is a possibility of confusion between his mark and the mark sought to be registered, the Patent Office resolves all doubts as to similarity between the marks and as to the possibility of confusion in favor of the opposer and against the applicant for the registration

This principle is illustrated by a recent decision involving the trade marks "Elgin American" and "Early American " A manufacturer attempted to register the trade mark "Early American" for cosmetics and saponaceous materials The registration was opposed by the owner of the trade mark "Elgin American" which was applied to vanity cases, face powder containers, and containers for other cosmetic materials The Patent Office and the Court of Customs and Patent Appeals concluded that there was a possibility of confusion between the marks and, applying the rule that all doubt should be resolved in favor of the prior user of the mark, refused to permit the registration of the mark "Early American" for cosmetics and saponaceous materials

Impatient

THE processes of the law are slow and inventors sometimes become impatient with its delays In a recent case the applicant for a patent believed that another person had copied his invention and was infringing upon his rights Instead of waiting for the issuance of his patent, he filed suit while his application for patent was still pending, charging infringement of the application While the suit was pending the patent issued

The alleged infringer of the patent then brought a motion to dismiss the suit on the grounds that the Court did not have jurisdiction because no patent was in existence at the time that the suit was filed The Court granted the motion and dismissed the suit, holding that the issuance of the patent during the pendency of the suit did not correct the defect existing at the time that the suit was filed

Trade-Mark Prints

THE manufacturer of a dress fabric containing a design based on well-known trade marks enjoined a competing manufacturer from selling fabrics containing similar designs. The

original manufacturer was licensed by the owners of certain well-known trade marks to use their trade marks under controlled conditions as designs for dress fabrics The infringer used the same trade marks without permission from the owners thereof The Court pointed out that the copying of a fabric design which is not protected by design patent cannot be restrained. However, in this instance the copying involved the use of well-known trade marks without the permission of the trade-mark owners Under these circumstances the Court held that the unauthorized use of the trade marks as a design for a dress fabric constituted unfair competition and an injunction and an accounting were awarded

Double Identification

An article of commerce may bear two trade marks and each mark may be separately subject to protection against infringement This is illustrated by a suit involving the infringement of the trade mark "Friendly" for shoes The manufacturer had used the trade mark "Friendly" together with the trade mark "Jarman" in the sale of its shoes The defendant, a retail dealer, used the trade mark "Friendly" but not the trade mark "Jarman" in connection with shoes coming from another manufacturer The dealer contended, among other things, that the trade mark "Friendly" was invalid because of its use with the other mark It is also contended that to be guilty of trade-mark infringement it would be necessary to use both of the manufacturer's trade marks The Court ruled that the trade mark "Friendly" was valid, that it denoted the manufacturer's goods, and that the use of this mark by the retail dealer constituted infringement

Frozen Lollypops

The ice cream lollypops which are so popular with children were involved in recent patent litigation A suit was filed against a manufacturer of such lollypops charging infringement of two patents, one relating to the ice cream lollypops *per se*, the other to the method of making them

In making the lollypop the stick was inserted in the ice cream at atmospheric temperature while the ice cream was in fluid condition Thereafter the ice cream was frozen with the result that it adhered to the stick

It was claimed by the patentee that this operation involved invention The Court, however, declared the patent invalid, referring to the age-old custom of children of inserting sticks in a snowman and permitting them to freeze therein In this connection the Court stated

"It is childhood knowledge that the stick for a nose in a snowman, inserted in the afternoon, is so frozen to the icy snow particles, that, in the morning, young fingers cannot pull it out"

(The Editor will appreciate it if you will mention Scientific American when writing for any of the publications listed below.)

ADVENTURES IN CONVERSATION is a 24-page illustrated booklet that deals with the art of conversation and the stimulating effect which it can have on every-day life. A good conversationalist can turn a dull subject into one that sparkles, can talk interestingly with conviction, can develop a personality which otherwise might be warped The pathway to developing the art of conversation is found in this booklet *Conversation Institute, 3601 Michigan Boulevard, Chicago, Illinois —Gratis*

ON THE JOB is a 32-page pamphlet that illustrates and describes more than 100 typical installations of Caterpillar diesel engines These installations cover a wide variety of fields including uses by cities, hotels, quarries, and cotton gins *Caterpillar Tractor Company, Peoria, Illinois —Gratis.*

STEREOSCOPIC EYES, by Dr C F Brindel, optometrist, is an 88-page book dealing with "how to see depth pictures without devices" It is Dr Brindel's belief that with proper training of the eyes, it should become possible for anyone with "just a pair of good eyes" to dispense with a stereoscope when viewing stereo pictures Dr Brindel explains the physiology of the eyes and provides instruction and suggestions on how fusing of the two stereo images may be accomplished with the "naked eye" Well illustrated with diagrams and photographs *Dr C F Brindel, 27 West 10th Street, Anderson, Indiana —$2 50*

PHILIPPINE MINING YEAR BOOK is a volume of over 200 pages which surveys the entire field indicated by its title It includes indexed sections covering the mining industries, mining companies, a mining staff directory, the Manila Stock Exchange, and a buyer's guide listing machine and equipment supply companies in Manila *Mining Yearbook, Inc, P O Box 297, Manila, Philippines.—$1 00.*

BROWNING 5-10 METER CONVERTER is an extremely compact unit for receiving two frequency bands when used in conjunction with any mobile, home, or aviation receiver. This instrument is described in Bulletin 106, obtainable from *Browning Laboratories, Inc, 750 Main Street, Winchester, Massachusetts —Gratis.*

ESSAYS ON HISTORICAL ANTHROPOLOGY OF NORTH AMERICA is a 600-page paper-covered book containing sections by outstanding American authorities on the early Indians of 15,000 years ago and later; archeology of the Southeast, Iroquois history, Great Plains Indians, Navahoes; Southwest and Great Basin Indians; also on Eskimo pre-history. Together, these chapters pretty well cover our present knowledge of the first Americans *Smithsonian Institution, Washington, D. C.—$2.00.*

PHOTOGRAPHIC CHEMICALS, THEIR PROPERTIES AND USES, by Henry M Lester, is a 32-page booklet reprinted from *Quarterly Supplement No. 3* to the *Photo-Lab Index*. Listing alphabetically the various chemicals used in compounding photographic solutions, this handy little guide includes for each of the chemicals, the chemical synonyms, chemical formula, common grades, uses In the case of poisons it provides antidotes The booklet lists about 400 chemical terms *Morgan & Lester, 100 East 42nd Street, New York, New York —50 cents.*

ADVENTURES IN BIOLOGY is a 101-page paper-bound booklet giving practical instructions for simple experiments in biology, mainly for teaching purposes *New York Association of Biology Teachers, Mrs Estella R Steiner, Grover Cleveland High School, 2127 Himrod Street, Ridgewood, Queens, New York, New York. —50 cents*

HIGHWAY RESEARCH BOARD, PROCEEDINGS NINETEENTH ANNUAL MEETING is a 578-page cloth-bound book that presents a wealth of information on various phases of highway design, economics, materials and construction, maintenance, traffic and safety, and so on All papers have been prepared by authorities in their own fields *National Research Council, Highway Research Board, Division of Engineering and Industrial Research, 2101 Constitution Avenue, Washington, D C —$2 25*

FARM WIRING HANDBOOK is a 28-page illustrated booklet that constitutes a guide for planning electric wiring on farms Such planning, properly carried out, makes for more efficient and convenient use of power *General Electric Company, 1285 Boston Avenue, Bridgeport, Connecticut.—Gratis*

FINCH FACSIMILE FIELD LABORATORY is an illustrated booklet describing facsimile transmission and reception, with particular attention to a mobile laboratory that is now being used for research in this particular branch of communications science *Finch Telecommunications Inc, 1819 Broadway at Columbus Circle, New York, New York —10 cents*

88 YEARS is an 18-page illustrated pamphlet that outlines the history and present status of the Studebaker organization. For 88 years this manufacturing unit has been producing vehicles that have played a large part in the development of the United States. *Glenn Griswold Associates, Public Relations, 330 West 42nd Street, New York City.—Gratis.*

Printed in the U S A Press of the Wilson H. Lee Company, Orange, Connecticut.

TO THE co-ordinated action of all categories of warships, in fleet operations, must now be added co-operation of and with the Air Force of the Navy Aircraft go with the fleet and operate with it offensively and defensively In our cover, an official U. S Navy photograph, battleships and aircraft are shown in recent maneuvers

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SCIENTIFIC AMERICAN

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NINETY-SIXTH YEAR • ORSON D. MUNN, Editor

OCTOBER • 1940

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MYTH? PART TRUTH?

AT LAST a way to put the Lost Atlantis tradition to a scientific test has been found. Readers will recall how Plato recorded a story, which in his time was already 8000 years old, that a vast land lying west of Gibraltar and containing a great empire, in a day and a night sank beneath the sea. The belief, therefore, that the rich cities of a civilization more advanced than our own lie today in all their arrested splendor burns bright in the souls of modern Atlantis cultists. Is that tradition entirely mythical?

Lying 12,000 feet beneath mid-Atlantic waters is the Atlantic Ridge, a vast submerged plateau which some Atlantean believers identify with the Lost Atlantis. Why couldn't this have sunk? Do not parts of the earth's crust rise and fall, as geologists commonly point out? Aside from the fact that few geologists believe large areas founder deeply, the unusual feature of the Atlantis tale is the sudden submergence it calls for. Geologists deny its possibility.

Within recent years, however, new evidence has come to light that may encourage the Atlanteans. Perhaps, instead of itself sinking, the Atlantic Ridge plateau was laid bare by a subsiding sea and later flooded again by a rising sea. The discovery of large submarine canyons far below present sea-level now leads some geologists to believe that these were excavated by rivers flowing on what then was dry land. To account for this apparent anomaly, they assume that a great deal more of the earth's water was locked up as glacial age ice than has previously been thought. One geologist, A. C. Veatch, estimates sea-level in glacial times at 12,000 feet below present sea-level. This fits in nicely with Atlantean tradition.

If the waters gradually withdrew during 50,000 years of the last glaciation, the Atlantic Ridge might for many millenia have had a population. Finally, as polar ice melted away, the seas would have risen and the area would have been submerged—not, however, overnight or even over a lifetime—something geologists refuse to accept. (Incidentally, the inhabitants could not have been able to distinguish the rising sea from a falling land.) A tradition of sinking would have started among those who departed the area, and before long the story would have picked up trimmings, most certain of which would be a submergence with dramatic suddenness, for this would be too good a supplied detail for man to forego.

Methods of surveying the sea-beds with previously unhoped-for precision, by employing the sonic depth finder in connection with remarkably exact methods of measuring horizontal distances with actual tapes (wires), have recently been developed and proved good. In many places such surveys reveal a thing that makes geologists raise their eyebrows—a complex pattern of typical land-surface, stream-erosion channels. And now Capt. Gilbert T. Rude, of the United States Coast and Geodetic Survey, in the *Proceedings of the United States Naval Institute* for August, proposes that such a survey of the Atlantic Ridge be made.

Capt. Rude does not propose this merely to test the Lost Atlantis tradition, for it would have other and greater values to science, but he does point out how it might tend to settle this old question. If a typical pattern of stream-erosion channels—in other words, valleys—were found covering the Ridge area, this would tend to favor the Atlantis hypothesis. If only typically smooth, unchanneled sea-bed topography were shown, Atlantis would look still more like pure myth than it already does to most scientists.

However, even if the eroded land-forms were found, the real essentials of the Atlantis hypothesis, as its mystical proponents prefer to have them—that is, the great "empire" and the civilization "superior" to those of our own times and all that kind of thing which mystics and occultists dearly love—would scarcely be given encouragement; unless perchance the dredges of the Survey were to haul up from over one mile beneath the surface a golden throne and some things we benighted moderns could not yet understand, perhaps an atomic energy machine.—*A. G. I.*

FEEDING FOREIGNERS

UNCLE SAM is being urged by some well-meaning but near-sighted citizens to feed and clothe the needy of European countries which are now under the domination of the German war machine. Should such a plan be put into effect, it would surely prolong the present conflict and might even be the instrumental factor in tipping the scales in favor of a Nazi victory.

At the present time, Germany is reported to be stripping the invaded countries of all available food supplies, which indicates the effectiveness of the British blockade. Regardless of any promises which might be made by Germany, food and clothing supplied to invaded countries undoubtedly would be seized by Germany as a matter of self-preservation. The fact must not be overlooked that should the present blockade continue to be effective, the obvious strain on the resources of Germany in feeding itself as well as the populace of conquered countries might bring about an early cessation of hostilities.

While we have every sympathy for the sufferings of the people of Europe, we should steel ourselves to the fact that to rob Great Britain of the effects of one of its most potent forces—the blockade—might be the means of bringing about a far greater catastrophe.

A large amount of money has been solicited from the people of the United States for the purpose of aiding the destitute of foreign countries. In fact, one organization publicizes the fact that it has available many millions of dollars. There are in the United States thousands of people who are in absolute need and worthy of every charitable consideration. Would it not be a good idea to use the funds collected for foreign assistance for the aid of our own countrymen who are unable to obtain the necessities of life from other sources?—*O. D. M.*

50 Years Ago in . . .

SCIENTIFIC AMERICAN

(Condensed From Issues of October, 1890)

WAR BALLOONS—During the last sixteen or seventeen years, the Dutch government has been carrying on a more or less active war with certain tribes in Acheen, a district of Sumatra, the third largest island of the world, and with this view have dispatched a military ballooning contingent, under the direction of Mr Percival Spencer, an English aeronaut, to Kota Rajah, the fortified capital of the unconquered regions, where it is proposed to establish a permanent balloon reconnoitering corps to watch and, if possible, circumvent the strategical movements of the enemy

PACKAGE TRANSPORT—The portelectric system is intended for the transportation, not of passengers, but of mail and express matter only, at rates of speed approximating two miles per minute, the steel car being drawn along its confined path at this high rate by the pull of

numerous solenoids through which the track is laid, each coil exerting its power for a short time only as the car approaches it The passage of the car completes the circuit between the upper and lower rails through th solenoid in advance of the car, and the car is thus pulled into the coil until it is midway through the coil, when the current is cut out and transferred to the next coil in advance

TELESCOPE—The glass for one part of the great forty-inch objective of the new Southern California observatory has been received by the Clark Brothers, of Cambridgeport, Mass The telescope is to be mounted in an observatory upon Wilson Peak, of the Sierra Madre Mountains, 12 or 15 miles back of Los Angeles, Cal

GUN POWER—The range and penetrating power of modern rifles are tremendous The six-inch rifle will hurl its projectile through ten and a half inches of wrought iron a thousand yards from the muzzle The eight-inch rifle will pierce sixteen and three-tenths inches of iron at the same distance The ten-inch rifle that the rejuvenated *Miantonomoh* will carry will send its missile through twenty-one inches of iron a thousand yards away. The twelve-inch rifle, of which we are to have a supply in the future, will penetrate twenty-eight inches of iron at a range of three thousand feet

METAL VALUE—The price of platinum has recently advanced very greatly, until now it is nearly equal in value to gold In July, 1889, the price was $8 an ounce, six months ago it was $14, and at this writing it is $20 an ounce, while gold is quoted at $20 70 (*sic*) This rapid rise in the value of the metal is due to the steadily increasing demand from the manufacturers of electrical apparatus

CHOLERA—Advices received from Tokio, via Yokohama and British Columbia, contain intelligence of the terrible outbreak of cholera which has taken place in Japan, by the ravages of which upward of 200 deaths were occurring daily.

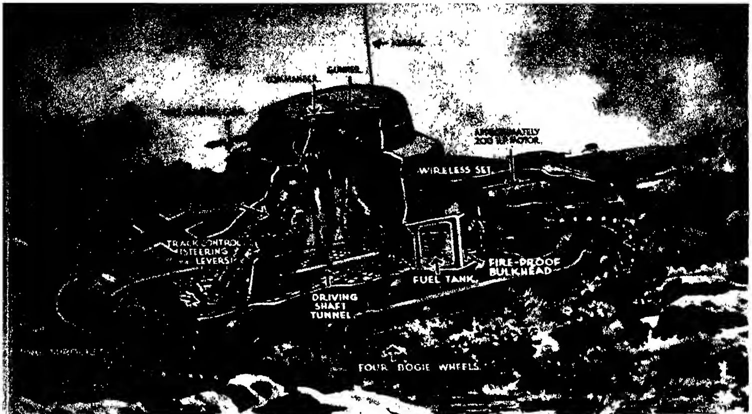
ANCIENT ROSE—At Hildesheim, in Hanover, there is a celebrated rose bush, the oldest in the world Charlemagne himself planted it more than a thousand years ago in commemoration of the embassy received from the caliph of the Thousand and One Nights, Haroun al Raschid

EXHIBIT—The 59th annual exhibition of the American Institute opened, in this city, on October 1, and is now in progress Among the photographic novelties is the slot machine for taking photographs. On sitting in position and dropping "a nickel in the slot" and executing some manipulations a photograph of the sitter is passed out.

PRECIOUS—Uranium was unknown a century ago, but a lode has been found in a mine in Cornwall, England It sells for $12,000 a ton

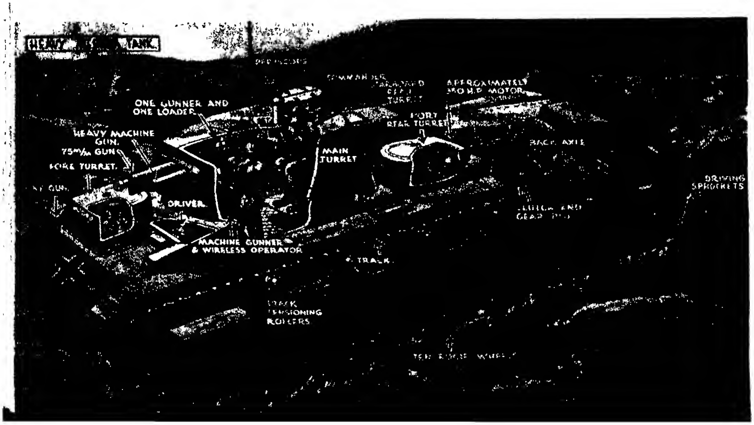
SHIPS WITHIN SHIPS—A floating island made of steel 1,000 feet long, 300 feet wide, and drawing 26 feet of water — such is the type of ship as described by Sir Nathaniel Barnaby Constructor Barnaby would load and unload his ship in midstream by lighters, and, instead of breaking their bulk, would take them aboard, hull and cargo, for his plan includes a clear sheet of water for them 'tween decks, a miniature harbor into which they may be floated at one port and floated off again at another Once the lighter fleet containing the ship's cargo is properly arranged aboard, the floating basin can be pumped dry and all comfortably stowed for the voyage — the sea being let in again after the ocean has been crossed, and the cargo thus distributed in many bottoms floated ashore

ADVERTISERS during the Fall season of 1890 included Keuffel & Esser Co. (surveyor's instruments), L S Graves and Son (elevators), Armstrong Man'f'g Co (stocks and dies), Hartford Steam Boiler Inspection and Insurance Co , The Eastman Company (Kodaks), G Gennert, (Montauk cameras), Rochester Machine Tool Works (stationary engines), Felt & Tarrant Mfg. Co. (Comptometers), Babcock & Wilcox Co (steam boilers); Overman Wheel Co (Victor bicycles), Smith Premier Typewriter Co ; Millers Falls Co (saws), John A. Roebling's Sons (wire rope) The Eagle Bicycle Mfg Co., Seneca Falls Mfg Co (foot power machinery), Edison Lamp Co.; L S Starrett (micrometers), The American Bell Telephone Co , The Pictet Artificial Ice Company, L Manasse (magic lanterns); Ingersoll-Sergeant Rock Drill Co., Rand Drill Co. How many of these names are familiar today or strike responsive chords in your memory?



ECHANICAL SHOCK-TROOPS F THE BLITZKRIEG

MODERN land warfare, as conceived by the Germans, puts the tank on the second line of offense, to follow the spearhead of the attack—the dive-bomber. Having built vast numbers of these mobile, light artillery units, the Nazis have been able to sweep irresistibly across several countries. Several types of tanks are employed, including the two shown here; a light tank, long type; a light medium type; and possibly larger types. The short, light tank, *above*, mounts machine guns, carries a crew of three, and has a road speed of perhaps 30 miles an hour The long, light type mounts a machine gun and either 37-mm or standard anti-tank guns The light medium tank is similar to the long, light type, but has a look-out hatch and heavier gun. The heavy medium, *below*, mounts a 75-mm gun in a turret, several machine guns, has a crew of seven Drawings from *The Illustrated London News*.



96TH YEAR

SCIENTIFIC AMERICAN

OCTOBER 1940

BOMBERS PLUS BATTLESHIPS

Both Are Needed For Co-Ordinated Effort

A. B. VOSSELLER
Lieutenant Commander, U S Navy

When the editor of Scientific American requested this article, he suggested the title "Bombers *versus* Battleships." Since the days of General William Mitchell, of the U. S. Army Air Corps, controversy has raged upon this subject and many articles purporting to analyze the problem of bombs, or bombers, *versus* battleships have appeared. Events abroad have intensified interest in this question and it is, therefore, quite understandable that the editor should think his readers would be interested in the subject.

In the writer's opinion, however, no more dangerous argument bearing on national defense problems than this very question of bombers *versus* battleships has ever occurred In the writer's view, it would be about as easy and conclusive to present a discussion upon the subject of brothers *versus* sisters or, to select an analogy closer to the question, infantry *versus* tanks, whereas the self-evident fact is that we need both The real question which every public-spirited officer of the Army or Navy, or for that matter, every public-spirited civilian, is interested in, is the broad question of adequate national defense rather than any narrow question of the transient superiority of some particular arm over another arm of the national defense, and that under certain given conditions Hence the title selected and used above.

There never has been any argument, to the best of the writer's knowledge, about the fact that a bomb, if it hits, will damage a battleship—or anything else which it may strike. There has been a great deal of discussion, some of it quite acrimonious, as to whether one bomb will sink a battleship and if not one bomb, then how many That type of argument proves nothing, beclouds the issue so far as the uninformed are concerned, and is generally destructive to the best interests of our national defense

The fact of the matter is that a battleship, or any other warship, is a very strongly constructed vessel and the damage which will be sustained by a hit from an aerial bomb will be largely determined by the location of the hit and the particular circumstances prevailing at the time

The whole controversy of bombers *versus* battleships is strongly reminiscent of similar controversies which took place years ago concerning the relative merits of battleships and destroyers, and likewise battleships against submarines At that time the proponents of the battleship stoutly maintained that the battleships were superior to the destroyer and the submarine, each with its torpedo; and the proponents of the destroyer and submarine were equally as insistent that their pet weapon had rendered the battleship obsolete. It should have been obvious then, as it is to all thinking people today, that neither was "superior" to the other but that, as in the controversy of the battleship and the airplane, new and highly destructive weapons for use in naval warfare had been developed.

It is submitted as highly significant that there has never been any great controversy in the Navy itself over the relative value of the bomber and the battleship and that most of this controversy has been thrust upon the Navy by others. The flyers of our Navy are not only naval aviators; they are also seagoing naval officers who understand the inter-relationship between the various parts of the Navy and therefore would no more sacrifice battleships than they would the Navy's aviation.

This is believed to account, in large measure, for the eagerness with which aviation was seized upon as a tool by officers of our Navy, once its teething days were over and the future stature of aviation became apparent to the discerning The result was that all phases of naval aviation were strongly pushed and highly developed with the further result, today, that U S naval aviation is preeminent in all its phases over every other air force in the world

Development has many times seemed maddeningly slow to the officers of naval aviation, but, as we regard the status of things at present, we find that, slow though it may perhaps have been, it has nevertheless been sure and steady and certain. The U S Navy today finds itself with aircraft carriers so far ahead of any others in the world in operating technique, training of pilots, suitability of aircraft carried, and, most important, training with the Fleet, that there is no comparison possible. In the same way, the long-range patrol bombers of the U. S. Navy are incomparably better in every respect than those possessed by any other air force in the world.

We have now, and have long had, more planes of this type than any other air force and newer and

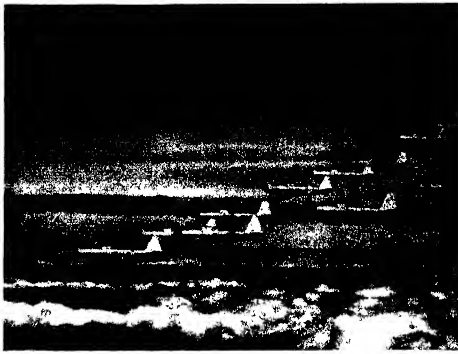
The opinions or assertions contained in this article are the private ones of the writer, and are not to be construed as official or reflecting the views of the Navy Department or naval service at large.

finer ones, embodying all the lessons from our wealth of experience in the past, are under manufacture and soon to be delivered The dive bomber, which has demonstrated its frightful power so overwhelmingly in the hands of the German air force, was pioneered, developed, and perfected by the U S Navy and today only the Germans and U S naval aviation have real dive bombers All our battleships and cruisers carry aircraft to be launched by catapults from their parent vessels and these airplanes also have no peer in any air force in the world The pilots who fly them have been especially trained and indoctrinated to work with their parent vessels and it is merely a matter of routine in the Fleet to use these aircraft for scouting, submarine searching, and spotting of gunfire

It will be seen from the above brief summary, therefore, that technically, and in the development and adaptation to naval use of new ideas, naval aviation has led the world Important and encouraging though this progressiveness and progress are, they are by no means the whole story, nor even the most important part

The organization of the German air force has recently been the subject for much argument and speculation Whether, however, Germany has in fact a separate air force, whether the air force operates under the army or vice versa, the real lesson that we should draw from the German operations in Europe is the extraordinary co-operation which has been exhibited between air and ground forces, no matter how achieved Destruction wrought by the German air force has been terrible to contemplate It is submitted, however, that such destruction, unco-ordinated with advance of the ground forces, would not have rearranged the map of Europe as we find it today

It is in this co-ordination between all arms and branches of German national defense that the *Luftwaffe* has displayed its outstanding qualities and it is in these same characteristics that the U S Navy, including its naval aviation arm, is likewise outstanding For years, naval aviation has been going to sea with the Fleet, daily, monthly, year in and year out, in each year for at least the last 15, naval aviation has played a large, and many times predominant, part in the annual Fleet maneuvers

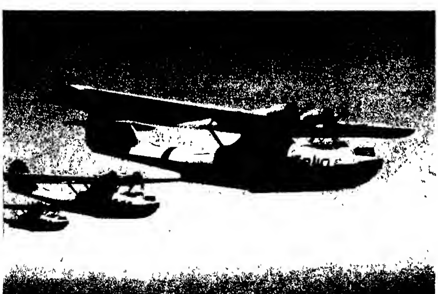


Photographs Official, U S. Navy

Hidden above a layer of clouds and catching only occasional glimpses

Most of the officers and men now serving in naval aviation have served in all its branches battleship- and cruiser-based, patrol plane and carrier squadrons In their years aboard battleships and cruisers, they have taken their turn at watch-standing and know as well as their comrades on general service duty what the mission of the surface vessel is and how that mission should be carried out. Aboard the carriers they have become thoroughly indoctrinated in the methods of co-ordinating and delivering the group air attack on both enemy surface vessels and aircraft and they realize full well that co-ordination, timing, and teamwork are the essence of any joint effort

In this connection it is of interest to mention that all of the non-flying line officers of the Navy are required to be familiar with the theory and practice of aviation and must periodically, before promotion, undergo examination in this as well as other professional subjects These non-flying line officers serving in battleships, aircraft carriers, cruisers, and tenders are, of course, continually working with the aviation personnel attached to these ships and they in turn learn



Sky-going ships of our aerial Navy. These patrol bombers have wide range and carry enough bombs to start and finish a battle-line job

of the ground, a utility squadron flies on toward its objective

in this practical way the capabilities and limitations of aviation

Those who serve in the patrol wing understand that, although they carry heavy loads of bombs, their primary mission is to act as the Navy's long-range, high speed air cruisers until the enemy is located and his intentions diagnosed. They understand the reason, too, which is that the mission of our Navy in the next war, as it has been in the past, will be to seek out and destroy the enemy completely and finally, using all the force at our command on the surface as well as above and below it. The fact that the British were able to evacuate some 300,000 men from Dunkerque to England under the very nose of overwhelming German air power has not been lost on these men and they want no sole dependence on air power which might allow such a thing, in reverse, to happen on our shores.

It is believed to be generally recognized now that one of the greatest and most far-sighted public services which was ever rendered the United States was the determined effort and successful fight waged by the high command of the Navy in preventing the formation of a unified air service to include naval aviation. We have before us several excellent, if also tragic, examples of the difficulties which the United States might now face had our present course of action not been followed. The principal one of these is, of course, that of Britain, wherein the Royal Air Force was set up as a third arm of Britain's defense with the result that the Fleet Air Arm cannot now afford the British Navy the strong air support which that Navy so badly needs. The final history of the present war will record the tragic loss of many British lives because of the slip-ups and misunderstandings inevitable under any such system of divided control.

The above record of progress and accomplishment has been set down so that the reader may understand why we in the Navy consider the "bomber *versus* battleship" question an abstract argument. The problem facing the Navy today is to build, upon the excellent nucleus we now have, the expanded naval aviation of tomorrow, maintaining the co-ordination we now possess so that when and if our Navy goes into battle, all its components will be there in adequate number and all will be working together in the most efficient way to achieve the final result—total defeat of the enemy.

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AIRCRAFT versus WARSHIPS

ALTHOUGH Mr. Charles Edison, when Secretary of the Navy some months ago, stated that airplanes have a temporary advantage over battleships, it is apparent that protective measures for the ships were already known. An editorial in a recent issue of *The Engineer* (London) discusses this matter in detail and states the protection necessary. We quote below a pertinent part of that editorial.

"We have now had experience of many months of war, and it is not unreasonable to inquire whether this question can yet be answered. It is, of course, less a single question than a group covered by a single title, for there are ships and ships. If we consider first the vitally important question of the battleship, it may be said at once that we do know a great deal more than we did. It is true that we knew beforehand that the battleship of today

Torpedo planes, dive bombers, and cruisers—they're all part of the team. Properly co-ordinated, they make a powerful defensive arm

was strongly protected by deck armor and was difficult to hit. To penetrate armor requires high striking velocity, and this, in turn, calls for a high altitude of attack on the part of the aircraft, though the greater this height the less chance of hitting. Hence the two chief attack requisites were, and still are, mutually conflicting Nor can modern developments materially affect this position.

"The bombs now in use are better streamlined than in the last war, and they are heavier, but even so the velocity they acquire during descent remains much where it was Even were air resistance entirely removed, the vertical velocity attained from any height could not exceed that corresponding to a vacuum trajectory, which from 20,000 feet is but 1100 feet per second; in practice it would, of course, be materially less, and even were the height of release pushed up to 30,000 feet, or even 40,000 feet, the velocity would be but little greater since, in the neighborhood of the speed of sound, the rapid rise in air resistance cushions further increase Nor could an attack during a dive from high altitude materially alter the situation, since an initial downward speed of even 400 feet per second would hardly affect the velocity at sea level To fire the bomb downward fast enough to increase the ultimate speed would, for a bomb of adequate size, require an aircraft gun of such dimensions and weight as to be outside the field of possibility, whilst any form of rocket-bomb is likely to present great practical difficulties Hence, if the armored deck can keep out a bomb which arrives with a striking velocity of 1100 feet per second, it can be said to have the latter beaten And this, our present war experience has shown it can do

"ONE at least of our battleships has been hit by such a bomb and the armored deck has proved to be just that protection which our naval architect said it would be Hence the contest between the battleship and the bomb has largely ceased to be the doubtful factor that it was It is true that this leaves out of account the 'near-miss,' the bomb which explodes under water close to the ship, but this should be regarded rather as an attack by a mine or aerial torpedo than by a bomb The essence of a bomb is to cause such an explosion inside a ship as will damage the vital machinery below the armored deck, or even hole the ship from the inside; whereas the object of the mine is to blow in the side or bottom of the ship by means of the intense pressure wave created in the water by its detonation. Hence the 'near-miss' must be looked upon as a mining attack and any battleship adequately protected against mine and torpedo may be looked on as protected also against the 'near-miss.'"

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HELLDIVERS

Describing the Technique of Dive-Bombing, Conceived for United States Naval Use

JAMES L. H. PECK

Author of "Armies With Wings"

YOU are at the controls of a rapidly climbing dive-bomber—the most feared, most spectacular of warplanes—miles out over the sea, leading a three-plane "V" formation in search of an enemy cruiser You level off at 8000 feet A moment later, you spot the warship off the port wingtip, you lift the microphone and radio a terse command to your "wing men" The one who is flying behind and to your right, slides over neatly and settles into place behind the left, or Number 2 "wing man." Now the dive-bombers are in left échelon, or step formation—an excellent arrangement for the attack

You swing in a wide curve to the left; it is early afternoon and you want to keep the formation between the sun and the enemy so that the ship's anti-aircraft gunners will find difficulty in spotting you Peering down at the dark sea to ascertain wind direction, to check the drift of smoke from the ship's funnels, you note that the wave crests are rolling in a direction almost parallel to the cruiser's course Good From the angle you are contemplating attack, the wind's effect will tend to compensate for the common tendency to bomb "over," or beyond the craft There will be just one attack; each plane is carrying an 1100-pound armored demolition bomb; each must count.

A succession of staccato explosions just reach you from below when they are duplicated a short distance above, and behind the formation. You make a sharp tack, then another in the opposite direction, then you lead the formation down about 200 feet and make another tack. Shrapnel, accompanied by blossoming, black puffs, burst where the planes were a few seconds ago Almost over the vessel now; you slide to the left just a bit The ship is turning, but it will be just right by the time the bombers drop down.

Another terse radio command. You roll the speedy monoplane over on its back, "peeling off" the echelon and heading down in one big hurry You are shooting down, a bit over on your back—upside down Now the plane is vertical, you're streaking down an invisible roller-coaster with the sun at the top The huge engine down ahead is throttled back, but not all the way, because the carbureter would flood and the engine would cool off too quickly Down at the bottom you're going to need all the engine you have to get up and away. You have trimmed the bomber's elevator tabs so that the ship is slightly nose-heavy, it dives better so Your eye is glued to the telescope sight, and you watch the cruiser's gray-looking deck and superstructure rush up toward you

THE sea grows bluer Guns, turrets, deck gear, and the scrambling crew become larger and more distinct, more detailed. Machine guns swing in the direction of your plane, you are literally flying down the gun barrels. But the sun is with you, protecting you Your left hand darts to the bomb release toggle. You bring the nose up a trifle, just before the toggle is pulled. If the ship were on its back or perfectly vertical at the time of release, the bomb would take a part of the propeller along as it dropped away.

Now! You can feel it as the bomber is freed from its half-ton burden You ease back on the control stick, and ease the throttle open. Ease is definitely the word: You pull out of the streaking dive in such a manner as to make it

easy on both the plane and yourself. A weighting force crushes you down against the seat, but there is no blanking-out of vision because the pull-out was gradual. Momentum of the dive, and the power of the engine, boost the dive-bomber up the other side of the invisible roller-coaster at a terrific rate

You look back over the tail at streaking tracers from the vessel's machine guns, but you've much too much speed Your Number 2 man comes out of his dive just above the pall of smoke from your bomb There's a flash and mushroom of evil smoke as his bomb hits the ship's taffrail. Then the Number 3 pilot lets go Just aft of the stern, you see a huge billow of white foam, then a geyser and an expanding ring of churning water Tiny splashes are everywhere, caused by the rain of debris

You throttle down so that the "wing men" can join up. But the formation is just a loose string, a follow-the-leader affair The cruiser lists badly to starboard Your gunner is watching through glasses from the enclosed rear cockpit Men are scurrying about the deck of the cruiser, manning the boats The ship is going down by the stern, slowly but steadily.

Again you pick up the microphone; but this time your message has to do with saving life, not the taking. You report the success and completion of your mission, and give the sinking vessel's position so that one of your destroyers can pick up the survivors.

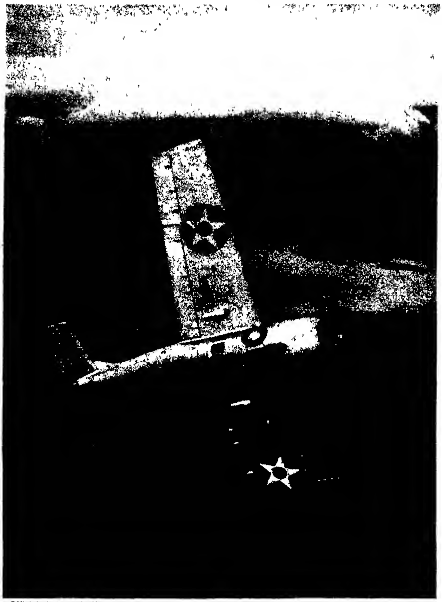
That is dive-bombing — the method by which more than a few ships have been sent to Davy Jones' Locker during World War II; the method by which Nazi fliers soften land defenses as they form the spearhead of the swarming *blitzkrieg* assault. This new tactical employment of the dive bomber against airdromes, fortifications and gun emplacements, troop concentrations, supply depots, and other objectives in the British back areas is designed to supplement artillery fire. Hitler's *Sturzkampfflugzeug* — literally meaning dive-fighter, and popularly known and feared as "Stuka"—wreaked havoc in Spain, grounded the ill-fated Polish Air Force in just three days, helped make central Norway untenable for the Allies, was a prime factor in bringing about the capitulation of France

Photographs Official, U S Navy

Newest of our dive-bombers is this sensational Northrop XBT-1

Douglas TBD-1's, of Torpedo Squadron Five, "on the way down" in formation

MOST widely known "Stuka" is the gull-winged Junkers JU-87 monoplane which is powered by a 1000-horsepower Junkers Diesel motor, and has a top speed of 242 miles per hour. The outstanding features of this four-year-old, all-metal, dive-bomber are its wing flaps and slots and deflector fork. The flaps comprise four hinged surfaces on the wing's trailing edge which may be lowered to increase the air's drag, thereby slowing diving speed from 430 miles per hour to just a few miles per hour more than the ship's top speed in level flight Used in combination with these "diving brakes" are two slots or foils in the leading edge of the Stuka's wing—all of which make for bombing accuracy, in that the craft can dive within a few hundred feet of the ground to release its deadly cargo The "Stuka's" deflector fork is the bomb rack gadget which lowers the 1100- or 550-pound bomb so that it will clear the arc of the propeller blades when released The bomb is carried snuggled up against the center section of the wing to diminish air resistance. When the pilot makes ready to dive, the rack is extended Additional firepower consists of four 110-pound bombs carried in wing racks, and three .312 caliber Rheinmettal - Borsig machine guns, two in the wings and one



Official photograph, U S Navy

Grumman mid-wing fighter "peeling off" into a dive. "Peeling off" increases accuracy, as pilot can keep target in sight; when nosing over into a dive, motor and cowl hide target until ship is at a steep angle

for the rear gunner to ward off back-biters

Closely resembling the Junkers plane is the B & V Hamburger 137—an all-metal, single-seater having the same up-swept wing and pointed nose The Henschel 123 is a stubby biplane powered by a radial air-cooled engine, it carries the same armament and bomb load as the more widely known Junkers All three prototypes were originally classified as attack planes or *Schlachtflugzeug*, and they engage in attack-plane tactics as well as dive bombing The latter are employed against more or less isolated objectives whose destruction calls for extreme accuracy. When strafing enemy troops, however, the attack-plane tactics demand low-flying assaults in which the "Stukas" do not dive steeply, but maneuver on level keel.

Machine-gun fire from craft flying at tree-top altitude in horizontal attitude describes a grazing, creeping barrage, while that from planes in a steep dive is necessarily limited in its forward travel The level assault offers more protection, in that hedge-hopping "Stukas" are within sight and range of ground machine-gunners —larger anti-aircraft guns are useless against planes flying lower than 100 feet—for the shortest possible time When diving at a steep angle, they may be seen and fired upon as they are on the way down and, necessarily, on the way up following the pull-out. Low-flying craft are difficult to perceive from higher altitudes, and this offers some protection against enemy pursuit planes "Stukas" operate in three-plane units in both diving and level-flying assaults

Because of the sensational success of both dive and attack tactics in World War II, it would seem that these are new applications But Germany developed an attack plane —the armored, all-metal Junkers-Fokker, carrying three machine guns and some 200 pounds of bombs—early in 1917, and the United States conceived the dive-bomber, primarily for naval use, just ten years later The famous Martin dive-bombers and Curtiss "Helldivers," with their characteristic, back-swept upper wings, became the pride of the Naval Air Service, and the Curtiss 02C's did yeoman service with the Marines in Nicaragua.

Today, the all-metal Curtiss SBC-4 biplanes form a very important part of our Flying Fleet, together with the Douglas SB2U and Northrop XBT-1 monoplanes The former two are known as scout-bombers, like their brothers of the Army, the reconnaissance bombers, once they spot the enemy, they stop scouting and commence bombing The Northrop, newest of the Navy's dive craft, is a two-seater and strictly a dive-bomber There can be little doubt that, after the most convincing demonstration abroad, Uncle Sam will provide faster and better dive-bombers aplenty for U. S defense. The "Helldivers" have come of age

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SMOKELESS, FLASHLESS

New U. S. Powders Don't Betray Gun Positions

A superior quality of propellant powder will be manufactured at new powder plants which are to be built by the government near Louisville, Kentucky, and operated by the du Pont Company. When these plants are ready, the nation's present output will be tripled, these new ones making something like 200,000 pounds per day.

The new powder is not only smokeless but also flashless so that when a gun is fired at night only a dull red glow may be seen a short distance from the gun It is said even the noise will be decreased.

Sikorsky's Helicopter

ALEXANDER KLEMIN
Aviation Editor, Scientific American
In charge, Daniel Guggenheim School of Aeronautics, New York University

In our September issue we reported on Igor Sikorsky's views regarding the utility of the helicopter in military operation With these views we agree thoroughly But the pioneer inventor does not merely hold views, he builds aircraft to substantiate them Witness the VS-300 helicopter, recently constructed and tested in the plant of Vought-Sikorsky Aircraft

The new helicopter, as indicated in our photograph, is equipped with a single lifting rotor, three-bladed and 28 feet in diameter There is considerable advantage in a single rotor, because the maximum lifting and forward flight efficiency are secured thereby, and because the overall dimensions are kept down to a minimum Moreover, with the engine placed immediately below the rotor hub, the transmission system is reduced to its barest elements With a single lifting airscrew, there is, however, a turning moment to take care of, the fuselage and its occupants would otherwise spin around dizzily in space This difficulty is met by placing a small auxiliary airscrew at the very tail of the helicopter, rotating in a plane which is parallel to the plane of symmetry of the helicopter. With this plane of rotation, the auxiliary airscrew provides lateral thrust and the turning moment of this thrust counteracts the torque of the main rotor When the pitch of this auxiliary airscrew is varied, its thrust is varied Hence rudder action is provided.

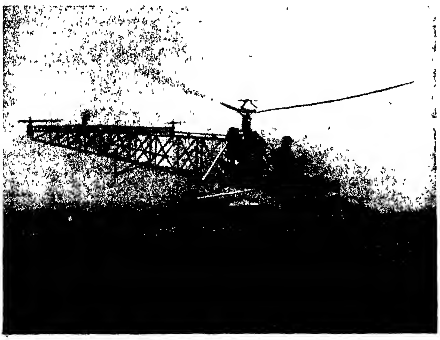
The reader will note that there are two other auxiliary airscrews, mounted on outriggers from the tail end of the main fuselage The pitch of these screws can also be varied at the will of the pilot If their pitch is varied simultaneously they give longitudinal control, that is, control in pitching the craft up or down If the pitch of the two outboard screws is varied differentially, they give lateral control like the ailerons of an airplane

Thus the Sikorsky helicopter has control about all three axes, (which is an essential of all aircraft) Since the controls are engine driven they are operable when the machine is hovering, while ordinary movable control surfaces are operative only when the aircraft has forward velocity

To secure vertical ascent it is only necessary to give the blades of the main rotor a fairly large positive pitch While the machine has not yet risen to very high altitudes, the photograph indicates that ascent has been achieved Forward flight is achieved by simply inclining the machine forward—that is, nose down—using the elevator airscrews for the purpose Thus the thrust of the main rotor has a forward component which serves to accelerate the machine in a horizontal direction As a matter of fact, the helicopter can go forward, backward or sidewise

In case of engine failure, the pitch of the main rotor will automatically decrease so that vertical or gliding descent at a steep angle will become possible just as with an autogiro The auxiliary screws remain in the same mechanical connection with the main screw whether power is off or on Therefore the auxiliary screws remain operative as controls even when the engine is dead

We congratulate Mr Sikorsky on an elegant solution of the helicopter problem, and await further progress with real expectations



Igor Sikorsky flying his helicopter

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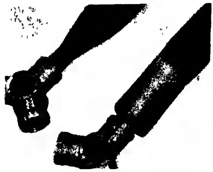
PROPELLER CUFFS



Conventional propeller shank, and shank with cuff (see below)

One of our photographs shows, in its upper left corner, a conventional type of Curtiss Electric Controllable Pitch propeller with the blade shank exposed At the lower right the blade shank is covered by a so-called "cuff" The cuff, of sheet aluminum alloy, continues the airfoil section of the blade, improves the streamlining and hence the efficiency of the propeller Moreover, the thrust of the propeller is now distributed more closely to its center so that air is driven backward forcibly to the inner portions of the engine Cooling is improved thereby The sheet aluminum cover is easily removed and serviced, and we should not be surprised to see the use of cuffs become widespread —*A K*

Geriatrics

The Newest Medical Specialty Deals with the Aging, Now that the Elderly Increase

BARCLAY MOON NEWMAN

WITH surprising suddenness, a new division of medicine has appeared—geriatrics—to help oldsters grow older, toward maximum longevity The name was coined long ago, from *ger*—indicating old age, and *iatrics* meaning therapy But, until a year or two ago, the specialty was little more than name

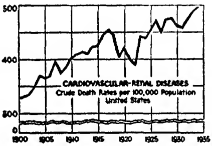
The aged we have always had with us Why this sudden great interest? We have only to look about us—to see more individuals than ever before in the upper age brackets

Greater than ever in world history are the odds in favor of our reaching advanced age. In Rome during the early Christian era, life expectation at birth was probably only 20 to 25 years. In certain European cities of two centuries ago, the newborn could expect to live 25 to 35 years In the United States, just after the Revolutionary War, the expectation of life at birth was 30 to 35 years, in 1900, 50 years, today, white male babies can look forward to 60 and female to 63 years The increase in expectation of life, at birth, since 1900, slightly surpasses the increase during the previous 100 years. By 1960, a newborn boy of this country may expect to live 75 and a girl 80 years

There has been no observable increase, however, in the maximum length of life attainable by the most longevous man or woman Persons surviving to advanced ages do not live longer than formerly In fact, it is believed that those who, in 1890, reached three score and ten could expect more years than men and women who today are entering their eighth decade

Only the average duration of life has been increased Thus, in 1890, 72 percent of U S boy babies attained the age of ten, now more than 91 percent do. The early dangerous years are more often survived, and so the average age at death has gone up. Medical discoveries and their wide application, public health measures, improved nutrition, the elevated standard of living, and education, deserve the credit The chief successes have been over microbic diseases—smallpox, bubonic plague, yellow fever, typhoid, diphtheria, tuberculosis And newer nutritional discoveries may right now be in the midst of adding another 10 percent to the present average age at death

In the meantime, the birth rate has been declining By 1950, ac-



An effect largely of aging population is the upward trend of the curve: more people live long

cording to some calculations, our population will have become stationary, with the number of births equaling the number of deaths

Declining birth rate and declining mortality rates for infancy, childhood, adolescence, and early adult life co-operate to yield an aging population. A century ago, youngsters under 20 made up half our population. Today only a third of U S individuals are in this group A century ago, less than three percent of the population were elderly, that is, 65 and older. This percentage has already been doubled Within another half century, men and women past 65 will make up more than 15 percent of the total population. More striking, however, is the fact that about 27 percent of us are today already 45 and older. In 1980, more than 40 percent of U S persons—infants to oldsters—will be 45 at the youngest In another ten years (1950), the elderly (those past 64) will be as numerous as children under five years of age—the percentage of each in the total population will be about eight The geriatrician will have as many patients as the pediatrician.

Pensions, old age "economic" schemes, and old age pressure groups have come to the fore, and doctors, like the rest of us, are awakening to the results of the crowding of the higher age brackets The social and economic results are going to be enormous Business and its advertisers must take into account the aging of the "average" consumer, who will have different tastes, interests, attitudes, habits, pleasures — and, above all, probably, increased conservatism. The dependent oldster is replacing the dependent youngster

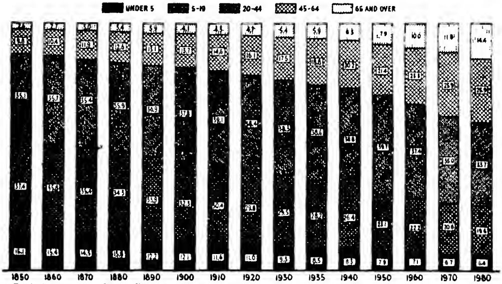
The average doctor notes not only that his average patient is older but also that the number of aged patients has increased Old age is commonly said to begin at 65 However, many individuals are really younger at 75 than the average person is at 55 to 60 Time is a poor indicator of degree of senescence

THE geriatrician does not find new diseases appearing after a certain age. The elderly have practically all the diseases of youth, but none additional At certain ages, however, certain disorders are more common The so-called degenerative disorders—especially of the circulatory system, the kidneys, and the brain—are less frequent in youth, more frequent in the upper age brackets Sexual decline sets in usually during the middle years, if not before, so is not a problem for the geriatrician alone.

Heart disease takes its greatest toll during the fifth decade, and then declines in relative importance—though still very important —as far as geriatrics is concerned Arteriosclerosis, found even in babies, is almost universally present in oldsters Chronic high blood pressure becomes more and more common as years are accumulated. The kidneys increasingly are sources of ills as the decades pass. Heart, blood vessels, and kidney pathologies carry off two thirds of those dying between the ages of 80 to 89 Cancer, also found even in babies, is most common in later years For white males, cancer reaches its mortality peak between the ages of 60 and 69, but during the next ten years is almost as im-

portant a cause of death. Among women, cancer is most prevalent from 50 to 59, but during the next 20 years the mortality remains high—second only to mortality from heart, blood vessel, kidney diseases. The mortality hazard of tuberculosis attains one peak in the middle twenties, and a second peak in old age. After 60, the tuberculosis death rate rises sharply, the aged having a lower resistance to this disease than the middle-aged.

The geriatrician, then, must be especially expert along specific lines Furthermore, in advanced age, though there are no new disorders, the same disease usually runs a course markedly different from that followed in earlier decades The tissues and organs have changed with time—some say because of time, but nobody can prove this speculation The reaction of the old body is different, and so are the symptoms and the treatment Fever typically present in the diseased person of lesser years may often be absent; in lobar pneumonia, the patient may stage a quiet, fadeout without fever Appendicitis simulates mere intestinal obstruction.



Illustrations courtesy Metropolitan Life Insurance Company

What medicine, public health measures, improved nutrition, and better education are doing to the age composition of our population. 1850-1930 are from census data, 1940-1980, estimated by Thompson and Whelpton

Generally, in the old, there has been loss of weight and height The fat depots beneath the skin, as of cheeks and temples, are much reduced. The skin itself is, as we all know, markedly altered more pigmented, drier, rougher, wrinkled of course—though the degree of wrinkling is not a good indication of age The sweat glands and oil glands are wasted The muscles are deteriorating, perhaps undergoing fatty degeneration. The heart is enlarged, and has deposits of abnormal substances, as do the blood vessels, now much less elastic Lung capacity is much diminished

The bones have become somewhat porous and fragile from loss of calcium and phosphate and from gain of organic matter. There is less cartilage. The spinal curves are accentuated.

Digestive secretions are less in quantity and potency. The stomach, for example, is much less efficient, the gastric juice having a diminished content of hydrochloric acid. The alimentary tract is liable to bulging and the motility of its muscular walls seems to be weaker.

The liver, kidneys, spleen, pancreas, and brain are smaller and firmer, and their active cells have been extensively replaced with relatively inert fibrous tissue and fatty or other growths Nerve cells of brain and spinal cord have accumulated mysterious granules, called waste materials by some investigators Tonsils and lymph nodes are extremely shrunken, and the enigmatic thymus gland, too The acid-alkali balance is readily upset and more slowly returns to the normal condition when disturbed, as by toxic substances The lower extremities are less sensitive to vibrations Sense of balance is impaired In fact, as a general phenomenon, sensation throughout the body is impaired—"the organs suffer in silence," as one geriatrician puts it Even traveling gallstones, excruciatingly painful in more youthful days, may in the elderly pass painlessly down the duct from the gallbladder Youth's elasticity and resilience have sagged

Such changes encountered in younger patients would be called pathological. The geriatrician, rightly or wrongly, must nowadays regard them as normal or "physiological" He must not let these common or characteristic changes obscure diagnosis of outright—more serious or more rapidly acting—disease, for the time being, at least; senescence not being called disease To recognize disorder in the aged, the geriatrician must first be familiar with the moving picture of that which is termed "orderly progression of changes incidental to living long" It is difficult to know what is normal or orderly when most of the body is sinking into disorder, practically, the "normal" is the run-of-the-mine, or commonly observed, degeneration The geriatrician's task is all the more confusing when he encounters the stalwarts of 80 or even 90 who are evidentally old but still hale and hearty — with good brains, hearts, livers, and stomachs These stalwarts are either abnormal or supernormal! Their secrets the future may elucidate

Treatment in geriatrics is as specialized and difficult as diagnosis A severe disease frequently offers only mild symptoms until there is sudden collapse and death Reaction to drugs is greatly altered, they are absorbed slowly, and often fail to give their familiar results Heart stimulants may not stimulate, and sedatives may excite, usually do And the drug's effect today may be changed tomorrow Long stays in bed are unsafe, pneumonia or suddenly increased heart weakness makes insidious attacks

On the other hand, the aged body has astonishing powers Contrary to popular belief, the aged endure surgery better than many youngsters. It is often stated that the wounds of the aged heal slowly Wounds in the adult of any age heal more slowly than wounds in the child After the middle years, there is no perceptible retardation

Diet is important. The vitamins of liver, especially the different vitamins B, have taken on increased importance for the geria-

trician; many of his patients are deficient in these Out of fear of food, many old men and women indulge in harmful food fads Still less fat should be eaten, and much fattening food avoided The lightweight wins the battle of the century Discoveries on the way may amazingly add to the life expectation after 65.

The geriatrician points out that the psychology of the aged is of immense importance Indeed, physicians are more and more impressed by the theory that the lifelong outlook has major effects on the body The chief cause of early death—before one's actually allotted span is accomplished—is surely the phrase "three score and ten" This phrase, the geriatrician knows, should be replaced by one indicating the real span of life Man possibly is endowed with a life span of more than *100* years—how much more, even the geriatrician with his rapidly increasing wisdom does not know But this new specialist, in an apparently discouragingly difficult field, is encouraged to find out—by keeping his patients well, if he can, well past the century mark In the meantime, the basic bio-sciences proceed with the still unavailing search for secrets of rejuvenation But of rejuvenation, the geriatrician can take no note, there is today no such thing for man or woman Tomorrow?

• • •

STEADILY BETTER

Three Decades of Science and Child Mortality

STRIKINGLY presented in the curves of the accompanying figure, from the *Statistical Bulletin* of the Metropolitan Life Insurance Company, are figures which show what three decades of scientific research has enabled medicine and public health to have done to cramp the style of a variety of prominent disease germs Encouraging are these accomplishments, especially since intensification of the same efforts are expected to continue their improvement

The curves are not based on the general average of the child population but on white children insured in the Metropolitan The children insured distinctly are not those of a favored class; they are the children of an urban, wage-earning group who take out small industrial policies — say, $250 — and pay the premiums at the rate of a few cents a week Figures for the general population would, however, not show much variation.

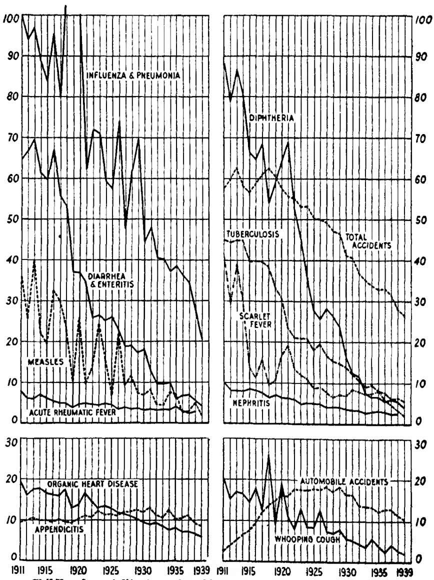
ROTO

New Cancer Treatment Method By X-Rays

AN improved method of using X-rays in the treatment of cancer hidden inside the body has been devised by Dr S J Hawley, Roentgenologist at the Geisinger Memorial Hospital, Danville, Pennsylvania, and is used with modern Westinghouse X-ray apparatus

"In the treatment of cancer hidden deep beneath the skin one of the limitations is the amount of X-rays which the skin can tolerate during treatment," Dr. Hawley states "The X-rays must pass through the skin before penetrating to the cancer, and, since the skin is closer to the X-ray tube, it is subjected to a larger dose than the cancer To get a larger dose into the deeply situated cancer without harming the skin, it has been common practice to aim two, three, four or more beams of X-rays at the cancer through separate areas of the skin This allows a large dose to be given to the cancer while spreading the dose over a large area of the skin"

Dr. Hawley's method is to spread the dose over the largest skin surface while always aiming the beam at the cancer, he places the patient on a turntable and rotates him during the treatment The patient is positioned on the turntable so that the cancer is centered on the center of the turntable and the X-ray beam is aimed at the cancer



Childhood mortality (ages 1 to 14 years) by cause, from 1911 to 1939

WE CONSUME—The average American each year requires only 30 pounds of textile fibers and a ton of food, to meet his power demands, however, he burns 10,000 pounds of coal and oil and salvages still more energy from waterfalls, wood, and wind —*The Industrial Bulletin* of Arthur D. Little, Inc , No 160

OUR DAILY BREAD—Three pounds of food and four pounds of water a day will keep the body functioning, but these would be of little use without 34 pounds of air daily —G R Harrison, "Atoms in Action," page 293

MILES OF R R TRACKS—If all the railroad tracks in the United States were so laid out, they would form 133 parallel tracks between New York City and San Francisco —Association of American Railroads

LEGS GROW MAINLY NEAR KNEES—Contrary to what one might assume, the leg bones do not make their longitudinal growth at the same rate throughout their length Most of the growth occurs in the region of the knee joint —*The Journal of the American Medical Association*, August 10, 1940, page 479

MAN'S BUMP DEFLATED—Recent work by Federal entomologists shows that when mosquitoes have free choice they prefer horses and cattle to human beings by about six to one Pigs were three times as popular as humans Dogs were lightly preferred Man rates just ahead of chickens and cats as a preferred source of the blood meal which most of the biting mosquitoes require before they can begin depositing eggs —Notes, *Journal of the Franklin Institute*

SIZE OF RHODE ISLAND—Buildings cover one part in 2500 of the United States area (rough estimate) If brought together they would cover an area about 35 miles square —*Popular Astronomy*, August 1940, page 369

CIGARETTE SMOKE—A few lighted cigarettes can quickly fill an ordinary room with smoke, but the particles are so tiny that it takes 320 cigarettes—16 packs—to make one ounce of smoke particles —Notes, Westinghouse Electric & Manufacturing Company

STRAIGHT TRACK—A perfectly straight track—78.86 miles in length — on the Seaboard Railway between Wilmington and Hamlet, North Carolina, is the longest stretch of track in the United States without a curve —Association of American Railroads

IMPURE METAL—No metal has ever been made so pure that the spectroscope could not find impurities in it Even the superfine, extra-pure, 1000-proof gold which is the basis of the currencies of many countries is found to contain much atomic dirt under this revealing eye which sees through atoms —G R Harrison, "Atoms in Action," page 165

UNLUCKY FRIDAY—The reluctance of seamen to sail on a Friday reached such proportions that many years ago the British government decided to take strong measures in proving the fallacy of the superstition They laid the keel of a new vessel on Friday, launched her on a Friday, named her H. M S *Friday*. Then they placed her in command of a Captain Friday, and sent her to sea on Friday The scheme worked fine, and had only one drawback—neither ship nor crew was ever heard of again —*Our Navy*, Mid-August 1940, page 15.

POWER DIVE SPEED—A modern plane doing a power dive is moving as fast as a revolver bullet.—G R Harrison, "Atoms in Action," page 319.

50,000 PILOTS—The Civil Aeronautics Authority, charged with responsibility for training 50,000 civilian pilots by next June 30, already has launched more than 32,000 students in ground schools and 17,494 in flight courses in its Civilian Pilot Training Program —Robert H Hinckley, Assistant Secretary of Commerce

LARGEST U S LINER—During her recent sea trials, the S S *America* exceeded both power and speed requirements, and also bettered her guaranteed fuel consumption figure Designed to develop 34,000 shaft horsepower normally, she averaged 38,500 shaft horsepower during an overload test in the trials Her contract speed was bettered by over two knots —*The Log*, July 1940, page 24

DESERT BUSINESS—Death Valley, commonly thought of as an uninhabitable desert, has its attraction for visitors It is estimated that visitors spent more than a third of a million dollars in Death Valley during the season of October 1938 to May 1939 —*Economic Geography*, July 1940

LANDING BY INSTRUMENT—The instrument landing system [for aircraft] at Indianapolis is the most extensive and most complete system installed anywhere in the world It is an installation providing for instrument approaches and landings in four different directions All of the 16 stations involved are completely controlled and monitored from the airport control tower —*Journal of the Aeronautical Sciences*, July 1940, page 383.

ARMAMENTS COST—During the past five years, expenditures for armaments for the nations were, in American dollars Germany, 19 0 billions, Russia, 13 5 billions, England, 6 2 billions, United States, 5 1 billions, Japan, 5 1 billions, France, 4 9 billions, and Italy 3 7 billions In the United States and Engand, and probably in France, less was obtained per dollar than in the other, low-wage countries —Statistics by Colonel Leonard Ayres, Cleveland Trust Company

RUINATION THAT DID NOT MATERIALIZE—The consumption of marihuana in the United States, which had for several years increased, has recently been effectively checked —*Science*, August 9, 1940, page 118

PETROLEUM—Underground waste of oil virtually has been eliminated in the development of America's oil reserves. More than 99 5 percent of the recoverable oil known today in underground reservoirs ultimately will be produced by a continuance of present production methods —Notes, American Petroleum Institute.

ICE CREAM COWS—The total production of more than 1,000,000 cows, supplemented by many tons of fruit and other ingredients, goes to supply the 1,200,000,000 quarts of ice cream which Americans consume annually —*Telephone News Bulletin*, August 1940.

How Big Does The Moon Look?

In Which it Turns Out that Astronomy Has Something to Learn from Psychology

By HENRY NORRIS RUSSELL, Ph.D.

Chairman of the Department of Astronomy and Director of the Observatory at Princeton University Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington

THERE are some problems, related to astronomy, and perfectly susceptible to investigation by scientific methods, in which training in astronomical observation practically disqualifies one as an investigator

A very pretty instance of this sort was recently reported to the National Academy of Sciences by Professor Boring of the Department of Psychology at Harvard, and later discussed with great interest by a large group of astronomers, old and young, at the Harvard Observatory It deals with the old, every-day question: Why does the Moon look larger when it is low in the sky, near the horizon, than when it is high in the heavens?

Practically everyone, educated or uneducated, agrees that it does, except a very few hardboiled astronomers, and it is practically certain that these exceptional folk, being convinced that the Moon does not really look any bigger near the horizon, have trained themselves to disregard the ordinary "evidence of their senses"

This seems a very queer phrase to use; for there is of course no doubt whatever that the true angular diameter of the Moon, when seen near the horizon, is no greater than when it appears in the zenith This is true, no matter whether the diameter, in minutes and seconds of arc, is measured with a sextant, or whether photographs are taken with the same telescope or camera, and is certainly true also of the image of the Moon produced on the retina of the eye by its own lens apparatus

Other things being equal, the Moon actually looks *smaller* near the horizon; for, at any given instant, it is nearly 4000 miles farther away from an observer who sees it on his horizon than at his zenith, and so appears smaller by 1/60 of its apparent diameter. This effect, though very easily measurable with instruments, is too small to be perceptible to the unaided eye

The changes in the Moon's angular diameter with its changing distance are much greater, and extend over a range of more than 10 percent These could easily be seen without optical aid, by comparing the Moon on different nights with an artificially illuminated disk of fixed size and distance—say three inches in diameter and 27 feet away—but are not great enough to be detected by comparing what we see one night and what we remember of another. (Should any one wish to try the experiment, the disk should be put at a considerable distance, so that the differences in focus of the eye do not disturb the observations—which, of course, must be made with one eye only.)

THE increase of the Moon's apparent size near the horizon is therefore a phenomenon of psychology, and not of physics. The *angular* diameter is sensibly the same, but the *appearance*—that is, the conscious perception which follows automatically upon the sense-impression—is very different

Does our sense of vision then deceive us in this case? Before we answer, we must consider that what we perceive, when we look at an object, or hear a sound, is really an interpretation of our sense-impressions rather than the impressions themselves.

This process of interpretation must start very early indeed in our lives We can none of us remember when we learned that the person who walked across the room toward us was not really growing bigger, but coming nearer. The perception of an individual of fixed size coming nearer displaced that of an enlarging retinal image, long before we had words to express either. We left the unsophisticated impressions of infancy, and learned to substitute an interpretation based upon more complex experience so thoroughly that we are quite unconscious that we are doing it.

Familiar instances of this kind exhibit the almost universal fact that what seems to us to be the immediate evidence of our senses is a complex compound of the real sense-impressions and a mass of sub-conscious interpretation, based on our whole previous lives, and depending on a multitude of "cues" not part of the immediate sense-impression, but relevant to its interpretation

In looking at something at a moderate distance, we have the focussing of the eye on a near object, and the convergence of the two eyes, which gives the stereoscopic effect Both involve muscular adjustments which, though made without conscious attention, powerfully influence our distance-judgments

Professor Boring and his colleagues—trained psychologists, whose observations of their perceptions were not prejudiced, as are those of astronomers, by too much thinking about how the Moon ought to look—have found that the Moon, even high in the sky, produces the impression of looking as big as a disk 10 or 12 feet away, and of nearly four times its real angular diameter, while near the horizon it looks almost double this size. When the influence of extraneous factors is weakened, as by observing with one eye instead of two, by looking down a long dark tube, and so on, these effects diminish.

Another set of external "cues" come from the position of our head and eyes If we look at a low Moon, our heads are normally poised, and our eyes nearly level—that is, with the eyeballs in their normal position To see a high Moon, we must throw our heads back and turn our eyes up That these muscular adjustments have the principal influence upon the "horizon effect" is conclusively shown by the work of the Harvard psychologists When an observer lies flat on his back, and looks up at the sky, so that his head and eyes are in a normal position when he looks straight up, a high Moon looks big to him, and a low Moon, to see which he has to bend his head back, looks smaller. Curiously enough, the same is true of a low Moon in

the direction of his feet, for which he has to bend his head forward, and his eyes down.

Many other ingenious experiments confirm the conclusion that the position of the head and eyes is the principal factor which conditions our perception of how big the Moon looks. The fact that the Moon looks smaller if it appears to be below, as well as above, the observer's personal horizon, at right angles to his backbone, has naturally not been a matter of direct celestial observation.

In the summer of 1918, Dr D. L Webster—now Professor of Physics at Stanford, then a Captain in the United States Air Service—and the writer were engaged in work on airplane navigation at Langley Field, Virginia. One Sunday afternoon, when no work was being done, we were out on Hampton Roads in a sailboat—incidentally looking at the ships of the Atlantic Fleet, anchored in the Roads Next morning we were flying over the same spot—at perhaps 4000 feet—and we noticed independently that the warships, though at the same distance, looked from the air like toys—very much smaller than when seen on the level The impression was so striking that we commented upon it after our return Conversation in the aircraft of that date during flight was hardly possible, so that our impressions were strictly independent. Both were experienced in physical observation and both familiar—one highly so—with things seen from the sea and from the air

The question remains Why should an object, of the same angular subtense, produce so definite an impression of being largest when it is on or near the horizon? In the writer's opinion, the answer is to be sought in common experiences, involving an interpretation which, though geometrical in nature, is so simple that no formal knowledge of the science is required for it. Consider first, objects below the horizon We are all used to looking down from a height, a housetop or a tower, hill or mountain. (In these days, one might add an aircraft; but there has not been time for these actual birdseye views to become familiar enough to get into the sub-conscious level)

In the most of such views, we are looking down from a height upon a substantially flat surface—garden, field, or plain. The most rudimentary geometrical sense indicates that an object which appears at a large angle of depression, far below the horizon, is nearer us than one for which this angle is small, and it follows immediately that, of two objects of the same apparent angular extent, the more distant one must be much the larger We thus soon unconsciously learn to use different scales of real size for bodies of the same angular extent, but different angles of depression.

This is simple enough, but why do we do the same thing for the Moon, in the featureless vault of heaven? The answer, I think, is that the sky is not always featureless The stainless blue of a perfect day has little about it to make the sky seem nearer in one part than another; but, even then, the paler blue near the horizon suggests haze, and we all associate haziness of appearance with greater distance

But, very often indeed, the sky is clouded, wholly or in part, and more often than not, the clouds form an obviously flat ceiling at a definite (though not obviously measurable) height above the earth. Looking at such a ceiling from below we are geometrically in very closely the same situation as when we look down on a floor from a height The part of the ceiling directly overhead is the nearest, and the distance of other parts increases steadily with diminishing angular altitude above the horizon An isolated cloud, in a layer of broken clouds like the familiar "mackerel sky" will be smallest for the same angular extent, near the zenith, and larger and larger the nearer it is to the horizon.

In the language of the geometer, we project the observed pattern of clouds upon a plane surface at a fixed height above the earth, to get an approximate idea of the real dimensions of its components What we do practically is far simpler than this technical statement would suggest and is "obvious to the meanest intelligence"

It is not clouds alone that call for such subconscious estimates Birds, especially migratory birds, usually fly nearly horizontally, and everyone who knows the country at all must have seen a flock of crows change from mere specks low on the horizon to clearly-seen birds overhead, only to shrink again as they go on their way

These are common observations, which must have been part of human experience since men began to recall and act upon their past impressions. It is no wonder that, by this time, we have sub-consciously adopted different scales of real size for bodies high above the horizon and low down Rather may we wonder why the impression that the low Moon looks bigger amounts barely to a doubling in size instead of an increase of five or ten fold

It may be suggested that very near the horizon flying birds are too remote to be seen, even as specks, and distant clouds are lost in haze. Moreover—as everyone recalls who has seen a sunset at sea under a layer of scattered clouds—the clouds at very low angular altitude do not flatten out into nothingness as perspective on a plane would demand, but remain of finite size right to the horizon They are distributed on a spherical shell concentric with the earth—and the sense that clouds right on the horizon are not enormously more distant than those at an altitude of two or three degrees must have arisen long before the true geometry of the case was understood

When we can see the actual horizon, our sub-conscious correction-system is automatically referred to it When we cannot, Professor Boring's researches show that each of us has a personal horizon of his own—referred to his backbone as principal axis—with respect to which the illusion still persists—or, rather, the rational, though unconscious, attempt to make better sense of what we see than mere crude unthinking seeing would do

Further tests of this interpretation are possible. It would be very interesting to find out whether dwellers in mountain-sides, who, from babyhood, were used to seeing objects at large angular elevations and depressions, but at about the same distance, were subject to the "illusion" Observations from aircraft might also tell something. The writer vividly recalls the Moon sweeping from his subjective horizon to the zenith and beyond to the horizon in a few seconds, while the plane in which he was looped-the-loop at night, and has no recollection that it appeared to change in size But the time of observation was too brief and the conditions otherwise too unusual, to make this recollection of psychological value —*Jamestown, Rhode Island July 19, 1940*

When You Steer a Motor-Car

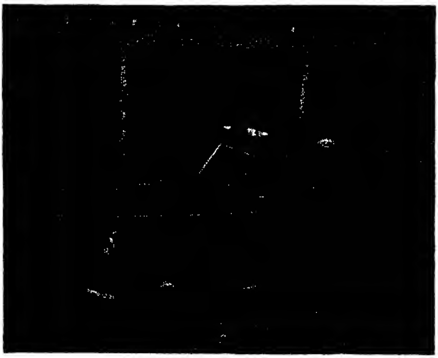
Mechanism Has been Designed to Indicate Steering Deviations When Car is Rolling

A. P. PECK

ONE of the main objectives of motor-car engineers is to design an automobile that approaches self-sufficiency, that virtually steers itself, that makes less demand on the attention of the driver as far as keeping the car on a straight path is concerned This apparently simple problem involves many parts of the car, as well as such external influences as wind pressure on the car body The separate actions of the steering gear, of all four wheels, of the chassis itself, contribute to the final result Yet these actions do not take place until the car is in motion, hence they are difficult to record and study

In order to determine the directional adjustment demanded by the modern motor-car—that is, the amount of steering which the driver must do to keep the car on a true course—and to obtain at the same time accurate data on the actions that necessitate this adjustment, engineers of Pontiac Motors have designed elaborate equipment that does what was heretofore considered impossible It makes records—24 of them a second —of exactly what happens to vital parts of a car when it is in motion over a road With these records

Below. Set-up of equipment on motor car for recording those factors which contribute to the necessity for directional adjustment. _Right:_ An enlarged frame of movie film taken by the camera on top of the car. Here are recorded the checkerboard background and the four indicating dials. _Upper right_: The "autosyn" motor, mounted on the front bumper, transmits, to its dial, indications of horizontal rear axle movement



available for leisurely study in the laboratories, the engineers are enabled to place their fingers on "reasons why" that might never be found otherwise

The equipment used involves a standard movie camera rigidly mounted on the roof of the car under test, a set of four dials placed on a bracket attached to the front bumper, means for actuating these dials, and a section of Proving Ground track painted in a checkerboard pattern. Available also is a huge airplane propeller with which cross winds of varying velocities can be simulated as desired. Supplementing all this is laboratory mechanism for studying and analyzing the movie film after it is processed

Accompanying photographs show details of the equipment. Attached to the steering wheel and to each of the front wheels are small "autosyn" motors by means of which any

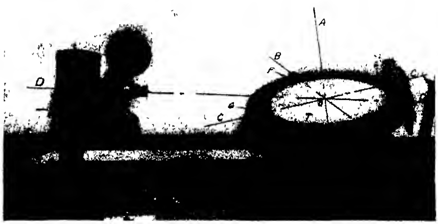
movement of these three units are recorded on three of the four dials Mounted low on the front bumper is another "autosyn" motor which is coupled through piano wire to extensions of the rear axle This arrangement is so devised as to indicate, on the fourth dial, any tendency of the rear axle to move in a fore-and-aft direction

When the test car is placed in motion over the checkerboard track, the movie camera starts to click off 24 frames a second This camera is so aimed that it photographs simultaneously the four dials as well as that part of the track directly in front of the car Thus is obtained a continuous record of the motions of the steering gear, of the front wheels, and of the rear axle, all correlated with the precise

Turntable and checkered disk for studying the movie film records of steering deviations

direction of the car as it travels along the checkerboard

After the movie film is developed there comes the laborious and painstaking study of the records and what they indicate In the laboratory is a turntable on which is mounted a disk ruled off into perfect two-inch checkerboard squares The turntable is movable in all directions, its motion being controlled by screws Any displacement of the turntable can be read, on calibrated scales, to degrees, minutes, and seconds A single frame of the movie film is projected on the disk, and the checkerboard image on the film is accurately aligned with the squares on the turntable When this registration is achieved, it is obvious that the disk bears the same relationship to the camera as the camera did to the road when the film was exposed. Thus, by comparison of successive frames of the film it is possible to



Movie projector at left throws film images on turntable at right. By means of accurate adjustments of table, valuable engineering data are obtained

calculate precisely the path of the car and the car's steering abilities The indications on the four dials show exactly what was happening at any split-second when the car deviated from the straight path From these data it is possible to eliminate "bugs" in design and to perfect not only steering mechanism but also other car parts that directly influence the steering of the vehicle

The mechanism described was developed under the direction of Thomas Carmichael, physicist in charge of instrumentation at General Motors Proving Ground, and William H Manning, assistant chief engineer of Pontiac Says Mr Manning "The information we have gathered and will continue to obtain by the 'checkerboard test' makes possible the development of a car whose safety built-in characteristics must of necessity supplement the driver's inherent ability "

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Carbon Dioxide on Wheels

Industrial Plants and Military Airports Are Using Mobile Units Carrying Fire-Killing Gas

With incendiary bombs peppering European airfields and supply depots, military aviation experts are looking to fire-fighting methods which can cope with this growing hazard A leading candidate for the job is the carbon dioxide fire-truck, a development that has proved highly successful in tests made by the British Air Ministry as well as our own naval airbase officials. The ability of the CO_2 to smother oil and gasoline fires quickly makes it doubly valuable at war-zone airfields where a fire serves as a beacon for succeeding waves of bombers if it is not immediately extinguished

Carbon dioxide fire extinguishing is not a brand new development, having been used for some time by oil refineries and other industries where flammable liquids constitute a hazard But the mounting of high-pressure cylinders, containing large quantities of the gas, on swift fire trucks which can dash around a far-flung airport and extinguish all manner of fires with clouds of the white vapor, is a recent advance This extinguishing technique has gained support as a result of its successful use by London A R P squads

Carbon dioxide, which is also used in aviation and marine installations in the form of small built-in systems for smothering engine compartment fires, functions by diluting the oxygen content of the air around a flame to a point where fire cannot burn This dilution is extremely rapid and the gas penetrates into crevices and past

obstructions which might hamper liquid fire-extinguishing agents Carbon dioxide, which becomes a liquid when compressed and turns to gas and snow when released, is harmless to human skin and materials, and recharging of the cylinders is quick and relatively inexpensive. Pressure within the steel storage cylinders is approximately 850 pounds per square inch at 70 degrees, Fahrenheit.

In addition to this main extinguishing agent, most of the new airport trucks are equipped with derricks and grappling hooks which can be thrown over airplanes to pull

Above: Airport fire-fighting truck that carries 1000 pounds of compressed carbon-dioxide gas as well as grappling hooks and a derrick. *Left:* A motorcycle unit used by the Navy. *Right:* A small trailer unit carrying 150 pounds of the gas

them out of range of a fire Ladders, asbestos suits, and gas masks for rescue work are other items of equipment provided for on these trucks, which are usually built on a commercial chassis and have speeds of 50 miles an hour

The gas cylinders are usually stored in banks at the rear of the driver's cab, and are manifolded to hose-reels which give a range of several hundred feet in all directions A supply of charged replacement cylinders is usually kept so that the truck can be used during recharging, which takes but a few hours Some truck models carry water-pumps, while those built for combat zones are usually made as self-sufficient as possible and carry their own supply of water in tanks —for use on hangar fires if hydrants and mains are damaged

Of the trucks so far ordered—and hundreds have recently been put into service at British airfields and training schools—few have had gas capacities of more than 1500 pounds, although tons of gas can be carried Engineers estimate that 1200 to 1500 pounds of gas is ample to envelop several planes and to enable rescue workers to get to the occupants

To supplement these larger units, or for use on smaller airports or manufacturing properties, a number of trailers and motorcycle units have been developed by the New York engineering firm of Walter Kidde and Company, who have also designed and produced many of the larger trucks The trailer units, which can be hooked to any handy truck or automobile, or even trundled to a fire by a couple of men, usually carry upwards of 300 pounds of the carbon-dioxide gas and are equipped with hose-reels and long nozzles to give the unit a wide effective range The motorcycle units, several of which have been purchased by American military fields, carry large quantities of the gas and can accommodate two or three men as they dash around an air-base They also carry portable cylinders of the highly compressed gas which can be lifted off and carried to the seat of a blaze

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NYLON

Slow Competition with Silk

Now that the first excitement over the introduction of nylon hosiery has subsided, people are beginning to wonder how deeply nylon will cut into Japanese silk production. Ordinarily the business of producing silk supports two million Japanese farmers and another half million people who reel and handle silk

Though American production of nylon will be rapidly increased, it is said that the full force of its competition will not be felt by the Japanese silk industry for five to ten years By that time Japan can have readjusted her economy as she did when rayon was first introduced. At that time she turned to production of the new fiber and is now one of the world's greatest rayon producers She may follow suit with fibers identical or comparable with nylon while silk production will be limited to supplying of a few "luxury" lines.

TURBINE SHAFTS

"Baking" Them Permanently Straight

A General Electric engineer, S. Homer Weaver, recently received a Charles A Coffin award from his company for his method of "baking" permanent straightness into steam turbine shafts and rotors. Turbine rotors weigh up to 10 tons and must retain perfect straightness at 3600 revolutions per minute and 950 degrees, Fahrenheit, operating temperatures.

In Weaver's process, the ma-

chined-straight shaft, or rotor, is suspended in a standard lathe bed The electric oven, sectionalized for different length requirements, is closed about it and controlled heat is applied through strip heaters The rotor is turned at two revolutions per minute, and thermocouples riding on it give temperature readings. As the oven heat is raised, the rotor loses its straightness. Sliding rods pass through the wall and, riding against the turning rotor, indicate increasing shaft deflection as the temperature goes up. Then, at a certain critical temperature, a straightness is restored which is not affected by temperature or temperature changes Thus the treatment is a true stabilizing cure

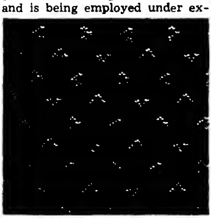
ELECTRO - COATED

High Pile Put on Textiles Electrically

"ARTIFICIAL lightning," which some years ago was converted into a useful tool for the manufacture of abrasives, is now being harnessed for an apparently unrelated purpose—the production of high-pile fabrics that resemble velvet, reports A J. Sidford, writing in a recent issue of *The Frontier*

Remote as abrasives and fabrics seem from each other, the principle underlying the use of electrostatic fields is the same in both cases As early as 1926, Elmer C Schacht produced sandpaper "coated by artificial lightning" at the Watervliet plant of Behr-Manning Corporation This patented process is used to do three things· propel, disperse, and orient the particles Since 1932 it has been adopted on a large scale in the manufacture of abrasives, both in this country and abroad

The same process was next applied to the tufting of dress fabrics, and is being employed under ex-



An "electro-coated" pattern

clusive license by Arnold Print Works. Accurately cut particles of cotton, rayon, wool, or mixtures are deposited, under the influence of the electrostatic field, in an upright position on the patterns, which have been previously coated with an adhesive.

Then came the latest step in the development—the complete covering of a cotton-backed material with accurately cut fibers. The fibers are securely anchored in a coating of vulcanized latex, producing a high-pile type of fabric that resembles velvet. The electro-coated fabrics are distinguished by depth of pile and density of coat

Enlarged section of Norzon fabric, showing erect fibers

Wear strain is taken on the ends of the fibers, which number as many as 300,000 per square inch, and tests indicate much higher durability than the older type These new pile fabrics, designated as Norzon, are being tested for upholstery by two leading producers of automobile bodies

Already it is fairly well established that electro-coating can be used for carpets with a very admirable pile surface That further research may uncover new applications seems entirely probable. A process that has already been adapted to the manufacture of abrasives and textiles undoubtedly has other uses as yet undiscovered

MIRRORS

Made By Automatic Process

A TOUGH film of silver of unprecedented hardness is achieved in an almost wholly automatic process of mirror making developed by Logan Porter Mirror Company The manufacturers claim that the silver solution is scientifically proportioned to every square inch of glass to be covered.

In this new process, glass plates are placed on a conveyor outside the processing rooms. Here they are flushed of all surface impuri-

Mirror production line

ties preparatory to a gentle, thorough scrubbing with distilled water inside the machines The sensitizing fluid flows from the laboratory above to each plate in an exactly adjusted quantity and the continuously operating conveyor carries the plate to the automatic silvering device The mirrors meet human contact only after the processing when the conveyor carries them outside the processing room to be stacked manually

CRANBERRY CHEMICALS

CRANBERRIES, graduated from the laboratory recently, came out with a product worth $80 an ounce! Chemists call it "ursolic acid." Cranberry growers call it a lucky break This hitherto rare, emulsifying agent which helps to make oil and water mix, is derived from the skins discarded in the manufacture of cranberry sauce. From the same "waste" product, cranberry seed oil, a rich source of vitamin A, can be obtained. Plans are afoot for a $50,000 "pilot plant" to pioneer the manufacture of the two new products.

CONTROL MECHANISM

Device Stops a Machine Error Before It Happens

A DEVICE which operates on the principle of acceleration rather than velocity and is sensitive to the rate at which a change is taking place rather than the extent to which the change has progressed has been developed in the Westinghouse Research Laboratories It actually begins to correct something that has started to happen before it can happen This is a new high-speed regulator which, in combination with a novel gyroscopic stability control, indicates the possibility of some promising applications for the control of mo-

tions and speeds in many mechanical operations and processes

"Experiments now in progress," reports M. W. Smith, vice president of Westinghouse, "indicate the possibility of using this scheme for the control of tension and gage thickness of steel produced on high-speed strip mills If this experiment is successful, it will materially reduce the scrap losses from off-gage material, which is one of the major problems in the steel industry today."

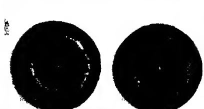
CLOTH TESTER

Machine Wears Surface Under Test Conditions

Developed for industrial use in determining abrasion resistance of plated metals, for example, the Taber Abraser has been adapted to testing of woven fabrics This adaptation is based on the continuous rotary principle, though the pressures against the specimen are considerably smaller than those employed in the larger abraser for use on paint surfaces

In the rotating head, a piece of the fabric to be tested is clamped tightly by the special ring that is employed for this purpose The motor then rotates the head at a speed of 60 to 70 revolutions per minute and the test is continued until the two abrasive wheels have worn the fabric to an appreciable degree Comparison between different kinds of cloth may easily be made by running each for the same period of time under the wheels of the abraser; the wearing quality of each may be determined under test with strict controls

Above: Compact cloth tester in use. *Below:* Typical cloth sections after test, showing how surface is worn by the Abraser



TACHOMETER

Needs No Contact with Rotating Part

Often it is desirable to check the speed of rotating or vibrating parts when it is impossible to get at those parts with an ordinary tachometer Such is the case, for example, with electric refrigerators, vacuum cleaners, electric shavers, concrete vibrators, and similar equipment James G Biddle Company has developed an instrument which overcomes this difficulty The new instrument, called the Frahm Hand Tachometer, is of the vibrating reed type and needs merely to be held against some part of the machine whose rotational or vibrational speed it is desired to learn In the accompanying photograph it is shown taking the speed of a vacuum cleaner.

When determining the speed of rotating parts with a new tachometer, it is only necessary to hold the tachometer case in contact with machine housing

The principle of this device is as simple as a tuning fork. The sole mechanism is a set of very accurately tuned steel reeds On the principle of resonance, certain of these reeds become energized by the vibration of the machine on which the instrument is held or mounted. The speed of the machine is then read on the scale of the instrument

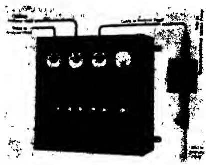
The advantages of this device are that it requires no contact with the rotating element, imposes no load on even the smallest motor, can be used in any position, does not have to be oiled, and has no wearing parts, no magnets, or electrical connections

GAS ATMOSPHERES

Indicator Keeps Constant Watch on Explosive Mixtures

In industries where hazardous mixtures of air and gases of any kind occur, it has been common practice to draw a sample of the mixture into a container which is then carried to a laboratory for analysis On the results of such a test, certain manufacturing controls or changes in operation may be made In this process there is not only a delay but also the possibility that the sample of the mixture may become contaminated

An analyzing unit called the Davis Continuous Combustible Gas Indicator prevents all such errors because its analyzing head is installed immediately in the area to be tested This indicator consists of one or more analyzing heads, a panel box, and a pump The sample of gas and air mixture is drawn through only a few inches of tubing and the determination of the mixture's characteristics is instantaneous Each analyzing cell, of which there may be a number installed at various locations, forms a part of a complete Wheatstone bridge circuit, the other half of the circuit being located in the panel box which is the indicating part of the system.



Panel box and analyzing head of new combustible gas alarm

CEMENTED CARBIDES

THE first World War saw the introduction of a material in Germany which has become an indispensable aid to domestic production in the present holocaust This material is cemented carbide (See Scientific American, February, 1935) Introduced to this country in the late twenties, the technique of manufacturing it to desired forms as well as the knowledge of how to use it in industry has improved by leaps and bounds Now the pressure of war preparation has brought it into full flower

Tools tipped with cemented carbides have permitted acceleration of metal cutting operations a hundred fold, and progressive manufacturers were fairly prompt to adopt them Now, even the backward producer must employ cemented carbides or fall behind because defense preparation allows no lagging Likewise, the marginal producer climbs aboard because it's necessity, not choice, which governs use

MACHINE TOOLS

You have heard lots about the shortage of machine tools and the high rate of obsolescence, but you rarely hear of the part the cemented carbides have played in bringing about this situation Machine tools wear out, but cemented carbides made them obsolete Old-style machine tools would not permit maximum use of cemented carbide tools They couldn't stand the punishment inflicted by the high operating speeds, hence much of the machine-tool replacement of recent years has been done to bring equipment into line with modern practice Fortunately for industry, machine-tool builders re-designed their product long before the present emergency

Incidentally, the centers of machine-tool manufacture are humming day and night A superficial survey of plant expansion made the other day revealed that more than 300,000 square feet of new manufacturing space is about to go into use

CIGARETTE PAPER

It seems most likely that laymen will feel the annoyance of war in small, incidental ways—at least for some time to come Apropos of this I anticipated trouble to the cigarette manufacturers due to the shutting off of paper from French mills But it develops that American mill capacity can be expanded to meet all needs and that there is plenty of flax grown in the United States to make all the paper we can use We already have a small production and a new company got into operation about a year ago Thus tragedy becomes an opportunity

SHEET-WIRE

No industrial process is free from the possibility of revolutionary change, looking to lower costs and better quality. Among the recent upsets, for which there is promise, is a wire-producing process which ignores the customary multiple drawing operations Here's how it works:

The first step is to butt-weld strip to permit continuous operation The strip is then grooved longitudinally between forming rolls Next step is to pass the grooved strip over vertically staggered slitting rolls to separate the strands At this stage an eight-sided wire emerges The finish operation, conducted in two stages, puts the strands through trimming dies to give the wire 16 sides (cross-section), but if wholly round wire is desired, a pass through a semi-drawing die does it

It should be noted that annealing and pickling operations are eliminated by this process as well as the use of multiple drawing dies Sponsors of the process are going to apply it to the manufacture of wire rod and hex bar direct from sheet bar, with the promise of cost saving

POWDERED IRON

A plant for the production of powdered iron has been projected for the West Coast, now that imports from Sweden are no more This news is significant for two reasons It represents a capitalizing on world trade dislocation to the benefit of domestic industry, it is proof of growing commercial importance of metal powders

Powder metallurgy evolved from the need to handle metals too refractory to be melted or cast conveniently First application was in production of tungsten filament (See February, 1939) It also permitted the combining of components which would not alloy properly because of extreme differences in melting points or because of immiscibility Since then a host of applications have been developed

What will be attempted in California is the gas-reduction of iron ore—novel in itself—with the stated benefit of obtaining a high purity product and accurately controlled carbon content due to the low temperature employed, which reduces the iron without a coincidental reduction of the oxides Also claimed by the sponsors is the opportunity to utilize large deposits of iron ore hitherto blocked by the lack of coking coal Large-scale user of powdered iron is the automobile industry, finding that many small parts can be made cheaper and better by compressing and sintering powders to exact form

SELF-SUFFICIENCY

Whatever our capacity to meet the exigencies of trade stoppage, whatever our ingenuity at substitution, time is the all-important factor in reaching self-sufficiency For this reason, every move made right now may be worth a hundred frantic moves made later Here, then, is progress to provide a cheery note

Anaconda Copper Mining Company announces the breaking of ground for a smelter, capable of producing 100,000 tons of manganese annually, starting six to nine months from now Manganese is an essential in steel production, which puts it at the top or near top as a strategic material A new process for extraction from low grade ores makes this project feasible

American Cyanamid Company, looking to the time when artificial rubber will swing into big production, is undertaking large scale manufacture of acrylic nitrile, one of the essental components of Perbunan

Koppers Company announces building of a plant for the production of ammonium thiocyanate crystals, hitherto imported This chemical, recovered from manufactured gas, is a base for many resins, has application in the textile, chemical, and metallurgical industries.

—Philip H. Smith

The Evanescent Mesotron

With Knowledge Incomplete, Science Strives to Account for some Puzzling Phenomena

C. W. SHEPPARD

ONE day in 1937 physicists studying the cosmic rays discovered another new sub-atomic particle This new physical specimen they named the mesotron, sometimes meson It was about 180 times as heavy as an electron and carried the same charge

Almost at once, a few of the Olympian souls who breathe the rarefied air of theoretical physics announced that this new particle would turn out to be one of the most important discoveries of the decade There are two reasons why they believe this to be true Let us consider the first.

As most persons know, the atoms out of which matter is constructed are tiny "solar systems" Each has a central nucleus and a number of electrons revolving around it, like planets around the Sun After many years of hard work, scientists have managed to push their explorations inside this outer group of electrons and actually find out what the tiny nucleus is made of. They will now tell you that it is a collection of two kinds of particles —neutrons and protons These particles weigh almost the same—about 1800 times the mass of an electron The proton carries a single electric charge, the neutron does not One can picture the average nucleus as a collection of protons and a slightly larger number of neutrons They cling together like a sort of popcorn ball, each one touching the next, and they perform an irregular spinning, vibrating, and churning motion around each other

But all was not plain sailing The thing which had to be explained was the nature of these sticking forces which caused the nucleus to be held together so powerfully against the natural electrical repulsion of the positively, and, therefore, like-charged, protons This glue-like force behaves in such a strange manner that it cannot be an electrical or a gravitational attraction but must be something new Electrical and gravitational forces act in a characteristic manner, they exert their influence over a large distance. For example, in the case of the attraction of the planets of the solar system, the gravitational force of the Sun acts with great strength over a distance of many thousands of times the size of the Sun itself Nuclear forces, however, are entirely different If one could get in and pry out one of the particles, he would find that this took a tremendous effort, but, once he got the particle out a little way, it would snap free and the force would drop off sharply Furthermore, the force is such that any particle in the nucleus is acted on by only a few other particles nearby, while the rest of the nucleus has no effect These peculiarities of nuclear forces have convinced scientists that they are here dealing with a brand new force hitherto unknown to physics

THEORETICAL physicists sharpened their pencils and went to work on the problem of these forces It soon became evident from theory that the force which a neutron and proton exerted on one another could be explained only if the two particles were constantly exchanging places This may seem a strange idea, but to the physicist it was no more strange than many other recent ideas about physical forces To explain it, consider for a moment the electrical force between two electric charges. How can one charge act on another which may be a long distance away? How can it cause that distant charge to move and how can it impart momentum and energy to it? One modern explanation says that the one charge gives out electrical disturbances, or "protons," such as constitute light and other so-called "ether vibrations," and that these electromagnetic corpuscles are absorbed by the other charge and act as energy and momentum conveyors between the charges

In 1935, this idea suggested to the Japanese physicist, Yukawa, that nuclear forces also possessed "carriers." But, unlike electrical forces, the nuclear forces require the proton and neutron to change places, as stated before. Yukawa explained this by saying that, in this case, the carrier was a charged particle If it were positively charged it could leave a proton, changing it to a neutron; and arriving at a neutron, it would change it to a proton (Figure 1, left). If the carrier particle were negative, it would do the opposite (Figure 1, right). This assumption of a continual stream of carriers going back and forth between protons and neutrons would account for the interchange forces. By a simple calculation, Yukawa was at once able to show that this carrier would weigh about 180 times as much as an electron

After the discovery of the mesotron, two years later, it took theoretical physicists very little time to

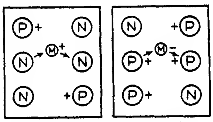


Figure 1: **Exchange of proton and neutron in atomic nucleus. *Left:* For a positive mesotron. *Right:* Same for a negative one**

agree that this was Yukawa's carrier particle An apparently crazy theory had carried with it a prediction which came true!

The new particle soon showed itself to be important for a second reason There are certain radio-active substances, either in nature or artificially made in the laboratory by nuclear transmutations, which eject electrons, either positive or negative It is known that, when a nucleus shoots such a particle out, a certain definite amount of energy is let loose. Unfortunately, however, if one examines the electron after it is emitted, one finds that it usually doesn't have the correct amount of energy, but a good deal less Scientists therefore have been forced to say that the missing part of the energy has been carried away by a phantom particle which has no charge and practically no mass—the one marked ? in Figure 2. This particle has been named the neutrino, but it has never actually been detected.

All this is bad enough, but let us consider for a moment: We have said that the nucleus consists of protons, neutrons, and carrier mesotrons alone If this is true. where do the ejected electron and neutrino come from? The suggestion soon was made that the mesotron is not a stable particle but that it disintegrates into an electron and a neutrino Its extra mass would then be converted into energy, in accordance with the theory of relativity, and carried away by the neutrino. Calculations showed that on this assumption the mesotron could last only a few millionths of a second before this decay process occurred

It was at once evident that, if mesotrons decayed in this manner, it should be possible to detect the

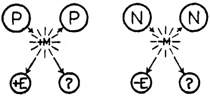


Figure 2. **New explanation of the radio-active emission of electrons from an atomic nucleus. In case I, at left, the electron emitted is positive and in Case II, at the right, it is negative**

decay in the mesotrons present in the cosmic rays A mesotron should, in such a case, decay in its rapid course within several hundred feet of where it was produced To test this assumption, Professor Bruno Rossi, of the University of Chicago, hauled a truckload of apparatus to the top of Mount Evans in Colorado At an altitude of 2$\frac{2}{3}$ miles, he measured the intensity of the cosmic ray mesotrons found there. He then descended to Echo Lake, about $\frac{2}{3}$ of a mile lower, and repeated the experiment. He compared the loss of mesotrons in the intervening $\frac{2}{3}$-mile air blanket with the loss in traversing a block of carbon of the same absorbing power and found that less than half as many got through the air as through the carbon. The conclusion was that, in $\frac{2}{3}$ of a mile travel, many mesotrons had had time to decay.

To settle the matter once and for all, scientists turned to the Wilson Chamber. This remarkable instrument works in the following manner: An enclosed glass chamber contains a small amount of water or alcohol. This evaporates, filling the vessel with saturated vapor. A

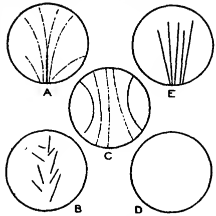


Figure 3: **How the five fundamental particles involved in modern theories of the atomic nucleus appear in the Wilson chamber.**

A: **Electrons make weak, straggling tracks which can be curved by application of a magnetic field perpendicular to the page. Positive electrons bend one way, negative the other.**

B: **Neutrons are not charged and thus cannot ionize the vapor in the chamber and leave a track. However, they are heavy enough to collide with protons, which then produce so-called recoil tracks having this characteristic appearance.**

C: **Mesotrons are hard to identify. When going fast they look like electrons; when going slow, like protons, though they curve more in a magnetic field.**

D: **The neutrino makes no track and is not heavy enough to make recoils, and thus cannot be seen.**

E: **Protons have a distinct and fairly heavy track which is practically straight except in fairly strong magnetic fields.**

piston in the bottom is suddenly drawn out This causes expansion, thus lowering the temperature enough to make the vapor condense The expansion is adjusted carefully until condensation just fails to occur If now any small, charged particle, such as an electron or proton, goes through the chamber, its electrical action causes the molecules of vapor in its path to become ionized These ions now act as centers of condensation which cause tiny droplets to form, and the result is a track which can be seen and also photographed.

Such an instrument was the ideal thing for detecting the decay of a mesotron, but it had one failing It is only when a mesotron is going slowly near the end of its travel that its track can be distinguished from that of an electron Thus, to the relatively rare occurrence of decay was added the further rarity of decay near the end of its course For this reason, many pictures had to be taken to catch such a rare phenomenon in the act of taking place.

Early in 1939, the English physicist, E J Williams, had set out to catch a mesotron in the act of decaying Within a few months his patience was rewarded, and he got a picture of the heavy track of a mesotron suddenly coming to an end in the chamber (Figure 3, *C*) From the end of this track came the very faint track of an electron, as called for in Figure 2. Since the neutrino, the other particle called for in Figure 2, has no charge, it produces no track and thus could not be seen

All the foregoing work has shown that the mesotron is just about what physicists have been crying for It casts new light on the nature of nuclear forces, explains the emission of electrons from radioactive nuclei, and strengthens one's belief in the existence of that phantom particle, the neutrino

But there still are a few unanswered questions It is known that forces between neutrons and neutrons, and between protons and protons, are almost as strong as those between protons and neutrons This indicates that there must be neutral mesotrons as well as the charged ones already discovered Certain meager evidence which has been brought forward to prove the existence of such particles has been felt to be entirely inconclusive.

Why are mesotrons not found in the laboratory? It is known that it takes about 100,000,000 volts to make a free mesotron. The only place where such energies now exist is in the cosmic rays At present, attempts are being made at the University of California to produce such high energies with the large cyclotron

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SPECTRO - PHOTOMETER

Analyzes Alloys By their Light In Less Than Two Minutes

An automatic machine which rapidly and accurately analyzes various materials, an invention expected to prove of tremendous value in accelerating the inspection of metals and alloys in the na-

tion's defense program, has been developed by Prof George R Harrison and his associates at the Massachusetts Institute of Technology, reports *Science Service.*

The device, known as an automatic high-speed recording spectro-photometer, not only analyzes materials, as does the spectroscope, but quickly draws the graphs and curves depicting the results of its analysis. It completes the entire process for a given sample in about 100 seconds—less than two minutes

Heretofore, scientists have used a spectrograph to analyze the material but they have then been forced to interpret this analysis on other machines, a procedure which often required half a day or more The new device makes records and interprets 20 measurements a second, doing so with an accuracy of one part in a hundred

The device covers a broad spectral range, making its investigations not only in the visible range of the spectrum but also in the infra-red and ultra-violet regions It is fairly simple in its operation and, according to Dr Harrison, could easily be adapted to other similar problems

HYGROMETER

Electrical Device for Measuring Humidity at High Altitudes

A NEW type of electric hygrometer has recently been developed by Francis W Dunmore, of the Radio Section of the National Bureau of Standards It has proved superior to other types for measuring upper-air humidities by the radio-sonde, because of its rapid response and ability to function at low temperatures It may also be used for making and recording humidity readings when the humidity unit is remote from the point of indication As it is comparatively small it may be used for measuring humidities in confined spaces

The device, which gives results accurate to within 2 or 3 percent consists of two fine palladium wires spirally wound about 1/64 inch apart, 20 turns per inch, on a thin-walled aluminum tube which has a thin insulating coating of water-resistant polystyrene resin The wound unit is then covered with a very thin film of partially hydrolyzed polyvinyl acetate with the addition of a small amount of lithium chloride The latter takes up water very rapidly With such a device the electrical resistance of the film between the two spiral coils is dependent upon the humidity of the air in contact with the film The variations in resistance

For measuring humidity

may change the audio note which the radio-sonde transmits or may be made to operate a direct-reading ohmeter with the resistance scale marked in terms of percentage of relative humidity

MORAL SCIENCE

Physical Science Becomes Dangerous if Dishonest

THE scientist is more honest in his work than is the politician because lack of morality in science is likely to destroy the experimenter, says Dr Harlow Shapley, director of the Harvard College Observatory, according to *Science Service* It is perversion of international morality, he believes, not of gadgetry, that has resulted in the decay of present-day society

"Morality in physics and chemistry is to some extent forced," he said "The scientist, naturally, is as human in his irrationality as others Survival, however, requires a kind of honesty The unmoral experimenter poisons himself or blows himself up

"If only a false economic doctrine, while still prenatal, would also electrocute its progenitor! Or an education schism backfire during fabrication and reduce its advocate to impotent illiteracy and confusions!"

A closer communion between the physical, psychological, and social sciences was urged by Dr Shapley as a means toward development, for the social and psychological sciences, of "a logical and rigorously experimental method similar to that which has brought such achievement in the physical sciences

"The value of these methods," he said, "are well-publicized by the success of everyday tools. You rely on your electrical refrigerator, designed by the engineers; but you trust mighty little your politicians and diplomats. Thousands of people ride in automobiles with complete confidence in their mechanism They worry not at all about the engine; reserving their anxiety for the unverified assertions of their Congressman, for the economic system, for the treachery of man in fields where a forced morality does not exist

"If we are to escape descent into darkness," he declared, "the scientist must join forces with other intellectual leaders, because on the advances in the educational, social, and political fields, does the advance of our science depend"

CATTLE PATERNITY

BLOOD tests can be used to settle paternity questions among cattle, Dr Lloyd C Ferguson, of the University of Wisconsin, recently reported Procedure, however, is not the same as in human cases Human paternity is decided on the basis of blood types, such as are used in "matching" blood for transfusions In cattle, the things used are antigens—definite chemical entities in the blood that react in the presence of one particular substance Cattle blood has been shown to possess something over 20 such antigens, each dependent on a single hereditary character or gene

WEATHER

Automatic Radio Weather Reporter Aids Study

AUTOMATIC weather observing stations, untouched by human hands for months at a time, may soon be scattered around on high mountain peaks or at inaccessible sea locations so that Uncle Sam's weathermen can have complete and automatic radio reports on the changing weather, necessary for predictions, says *Science Service*

An automatic radio weather reporter, developed by two National Bureau of Standards radio engineers, Harry Diamond and Wilbur S Hinman, Jr, with the co-operation of the Naval Bureau of Aeronautics, has undergone a successful two-months test at Naval Air Station at Anacostia

Radio messages that it sends out at predetermined intervals tell the barometric pressure, air temperature, relative humidity, wind direction and velocity, rainfall, and other meteorological factors.

Roots are Pumps

Research Shows Capillary Attraction Has Little To Do With Sap Circulation

PHILIP H. SMITH

TOMATO roots, no bigger than a piece of store twine, have a pumping mechanism capable of developing pressures of 90 pounds per square inch.

This is one of the recent findings of science and it may help to explain the phenomenon of sap rise which has puzzled scientists for centuries

If and when you studied botany, your professor probably gave you the "cohesion" theory to explain the movement of fluid in plants and trees This theory recognizes the enormous pull generated by evaporation at leaf surfaces and the fact that water has great tensile strength in capillary tubes It seemed to be the best theory available and even now it isn't voided by the revelation of root-pressure, but it falls short of explaining the sudden uprush of sap when there are no leaves to transpire, or how fluid can be lifted as high as 350 feet, as it must in the tallest trees

The reality of root-pressure was confirmed at the Rockefeller Institute for Medical Research as a sort of scientific by-product Dr Philip White, of the Department of Animal and Plant Pathology, was trying to find out how viruses are carried around in a plant which has no circulatory system such as is found in man He turned to the vitalistic root-pressure theory which had been advanced about 200 years ago by the Englishman, Stephen Hales, the extraordinary clergyman who first measured blood-pressure in animals, and invented the first gas mask and the first ventilating system for ships Hales' theory had been abandoned in favor of more mechanistic theories. He had worked with decapitated, dying roots and the slight pressure obtained was unconvincing.

To carry out his experiments, Dr. White built upon a previous achievement—that of being able to keep excised roots alive in nutrient. Roots can be made to live indefinitely, floating in a beaker, provided they are supplied with everything they get normally from soil plus what they would get from the air if they had the benefit of leaves—a sort of super-hydroponics

Just such a delicate root strand, kept alive for several years under artificial conditions, was selected for the experiment Its base was inserted in a glass tube, or capillary manometer, and anchored firmly in place with a rubber collar, to give a set-up in which part of the root was in the tube and part protruding into the nutrient The root then secreted water into the tube, building up pressure When the pressure mounted it became necessary to add a metal clamp lest the rubber be ruptured, but at no time could the root itself be crushed

When first attempted, the surprising pressure lifted the water to a height necessitating the running of the tube up a stairway to a second floor, and even that wasn't enough When mercury was substituated for water in the tube, the pumping was maintained with irresistible force. Finally, to keep the experiment within bounds, compressed air was applied at the opposite end of the tube and the root forced to pump against it, which it did readily

It was observed, also, that whether pumping against pressure or not, the rate of secretion displayed a diurnal rhythm.

Ninety pounds pressure represents the limit reached by experiments rather than the limit of root capacity When 90 pounds was attained, the root was still pumping, and Dr. White is of the opinion that pressure cannot be less than 150 pounds per square inch, and is probably more

Manometer assembly used in the study of plant root pressures

Root pressure apparatus showing air tank for back-pressure

One now wonders what starts the rise of sap in the spring Observing nature, one would guess temperature or light, or both acting together However, subsequent experiments, conducted elsewhere, under controlled conditions of temperature and light, failed either to stop or start the pumping, or to alter the diurnal rhythm Nature holds her secret close One might wonder, too, what difference there is in the constituents of the nutrient taken in by the root and the fluid secreted by it Are the nutritional elements removed, or are some food values passed along to nourish the rest of the plant which isn't there? The quantities available for analysis are so minute that special methods will have to be devised for such determination

Scientists do have an interest in trying to determine whether there is a diurnal rhythm in respiration rate corresponding to the rhythm of secretion If this could be established, it might reveal the mechanism which supplies the energy for the pumping

The nature of this work warrants the layman's critical "So what?" Are there immediate, practical results? The reply must be "No" We are simply further along in the understanding of plant physiology Add other facts yet unknown, to widen the horizon, and sometime the practical value mav emerge in the most unforeseen manner as it has in innumerable cases

Business and Changing Climates

Are Slow Climatic Changes the Basic, Underlying Cause of Economic Cycles?

CLARENCE A. MILLS, M.D., Ph.D.
Professor of Experimental Medicine at the University of Cincinnati

MAN is far from a uniform being of standard proportions and capacity for accomplishment—he differs widely from place to place and from time to time Years of investigation have revealed that the primary basis of these variations is the ease or difficulty of heat loss from the body.

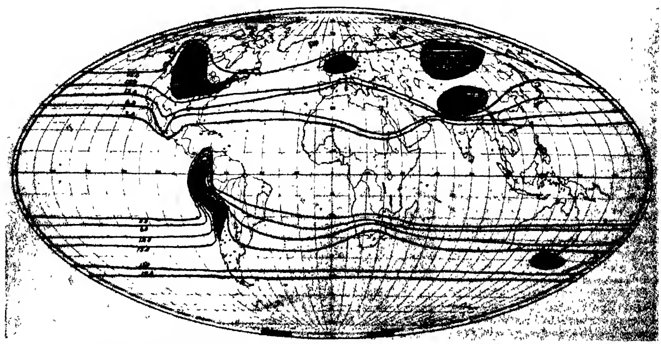
All bodily and mental activities or functions are intimately bound up with the combustion of foodstuffs in the cells and the liberation of heat and energy Every activity in the body is accompanied by and dependent on this combustion and heat production. Growth and development, ability to resist infections, as well as muscular and mental activity, are based on this internal burning of food materials Hence the factors that determine the combustion rate become dominant forces controlling the general activity and energy level of the individual

With man—and other warm-blooded animals—the body temperature is maintained at a constant level, usually above that of the surrounding environment So long as life processes go on, heat must be dissipated to the surroundings, else fever and death ensue Higher external temperatures, making heat loss more difficult, result in a suppression of internal combustion and a lowered level of vitality and general body function Growth and rate of development are slowed, resistance to infection falls, and energy available for action is sharply curtailed When body heat loss is accelerated by lower outside temperatures, just the reverse occurs. It is in the temperate regions of the earth, where body heat can easily be dissipated, that children are heaviest at birth, grow most rapidly, enter puberty earliest, and reach greatest adult size There energy available for action is highest and people are irresistibly driven into a restless activity that attacks difficult problems with a high degree of success.

In polar cold, however, body heat loss becomes too free, and, instead of human vitality and energy there rising highest, it tends to fall, as the body is faced with the necessity of using too much of its combustion activity merely for keeping warm. The exhaustion effect of prolonged cold is seen also in the temperate regions during late winter, when the death and sickness rates rise, and all other indices of general vitality fall.

Man, then, responds very definitely in a great variety of ways to the ease with which he loses his body heat The temperate regions of the earth are in general best adapted for his maximum activity, tropical warmth subdues his functions, while polar cold exhausts and benumbs This is a relatively new concept of the dynamics of human existence and of the part climate and rate of body heat loss play in life. Let us now see just what this concept means for mankind over the earth

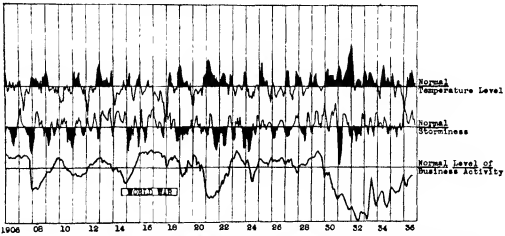
THE tropical lethargy and listlessness, carefree existence, together with retarded growth rate and body development, result directly from the difficulty people there experience in getting rid of the heat production that goes with a higher level of bodily activity. In the coolness of the temperate zone existence is on a faster, more energetic plane While infections account for most of the deaths among



Climatic stimulation over the earth. Index numbers represent intensity of the climatic drive

tropical natives of low vitality, in the energizing temperate climates it is body breakdown from the strain of a fast pace of life that kills the greatest number Vascular sclerosis, heart failure, diabetes, pernicious anemia, nervous and mental breakdown—these are the signs of stress that are mounting as causes of disability and death in the regions of most energizing climate.

It has ever been the people of cooler lands who have ruled over and exploited the less fortunate ones living under depressing, moist warmth In wars between nations the same energy gradient has also been a determining factor in the final outcome, for rarely can a low-energy people withstand armed forces full of vigor and determination



Weather stimulation and business activity (industrial area of the United States). Upper curve: Deviations from normal temperature. Middle: Deviations from normal storminess or temperature variation. Bottom: The fluctuations of business activity

Environmental temperatures and body growth. Smaller mouse represents average size of a large group raised in tropical moist heat (artificial), while those raised under identical conditions except in a cold atmosphere are represented by the lower one of large, robust form. But the ones raised in warmth live longer, though less actively

Regional differences in energy level have been of untold importance throughout the course of history, but there have also existed differences on a time base that have altered the destiny of individuals and whole population masses. The most common time change in energy level is the one that man undergoes as the seasons of each year pass. Energy in temperate regions rises highest through the fall and winter months and subsides to its lowest level in summer heat. Man actually uses less oxygen and has a lower blood pressure in summer heat than he has in winter cold

Unexpected and unpredicted changes in this climate stimulation, however, bring disastrous upsets in human plans, and with these irregular changes in earth temperatures go changes in human energy level and desire or ability to accomplish

Correlation of such temperature changes with business activity, back through the past 65 years of weather bureau records, shows remarkably high coincidence of business recessions with the periods of elevated temperatures, and of business booms during prolonged periods of normal or unseasonably low temperatures.

This basic dominance of all human function, and especially of economic activity, by the climatic drive, as body heat loss becomes easier or more difficult of accomplishment, deserves close attention and further study. With the rising energy tide of low temperature periods, business activity expands. At the same time the signs of bodily stress increase and death and sickness rates rise. In the periods of ebbing energy general health improves as business activity recedes to lower levels.

It has been man's failure to recognize this dominance of environmental stimulation that has made impossible a solution of the basic cause of economic cycles. Moreover, the irregularity of their timing has rendered difficult the perfection of plans for meeting the changes as they come

Fluctuations in the climatic drive, aside from the seasonal and irregular ones of short duration, have left their imprint on the history of nations back through the centuries The past two centuries of continuous temperature records yield an enlightening picture of the workings of this drive Outbursts of national expansion, as well as bloody revolutions for greater freedom of individual action, have shown an uncanny tendency to come during years of subnormal mean temperatures—years of the cold, stormy weather that drives men to greater activity

LONG undulations in earth temperatures have taken place and will undoubtedly continue in the future. Longest and greatest of these changes are represented by the glacial epochs and the intervening ages when tropical warmth spread well outward toward the poles. We are only perhaps 20,000 years away from the coldest part of the last glacial epoch, with a likelihood of generally rising temperatures for ten times that number of years to come Tne rise in temperatures has not been steady, however, but has come in 2000-year waves The most recent high point came with the warmth of the Middle Ages (800-1000 A D), while the subsequent low point occurred about the middle of the 19th Century After 1850, world temperatures rose slowly and irregularly for several decades, but since 1920 this rise has become more emphatic. In 1932 the bodies of Vikings were being unearthed in

excavations in Greenland after having been solidly frozen-in for almost 1000 years And with this recent warming-up has come a sharp turn back toward despotic forms of government all over the earth Man has felt weaker

With the cold of the last century came a marked increase in world population and such an abundance of energy and inventive genius as had never before been witnessed in human history Since 1920, however, population increase in many of the most energetic countries has shown signs of tapering off, with statesmen of several countries worrying about the possibility of an actual decline in numbers

We seem, then, recently to have passed a crest in human affairs and to be headed for a considerable period of recession The improvement in stature and trend toward earlier maturity, that has been in evidence during the past century, will no doubt be reversed shortly, for animal studies have clearly shown that these basic characteristics are closely linked to the ease or difficulty of body heat dissipation

What shall we do about it all?

Disastrous fluctuations in business activity might be robbed of their evils if we could predict the timing of the energy tides in man that seem responsible for the economic swings If the irregular fluctuations in energy and trade were as predictable as are the seasonal ones, we would be much less disturbed by them and be more inclined to take them in our stride, for panic arises from fear of the unknown In the individual phase of weather dominance, however, much can be done to relieve us from the undesirable aspects of such influence Through newer methods of air conditioning and control of indoor environments, we can to a considerable degree alter the effects of outside weather People in the tropics can raise their energy level and bodily vigor almost at will through indoor cooling to allow ready dissipation of body heat So also can the physical and mental let-down of mid-summer in temperate regions be eliminated by proper cooling, although it is a question whether it is wise to forego this period of lessened effort when the body relaxes and recuperates for the strenuous winter months to come

Much remains to be discovered in this matter of weather dominance over man Humanity really need not stumble blindly through the centuries, engaged in stupidly fighting deep currents of change which are based on forces whose magnitude dwarfs to insignificance man's puny efforts Is it expecting too much to hope that man will some day arrive at intelligent and understanding co-operation with these outside forces, instead of putting up a futile resistance to the changes they bring?

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TURKEY STEAKS

FROM the United States Department of Agriculture comes word of popular acceptance of turkey steaks. These steaks are small pieces of turkey meat and housewives can buy them wherever turkey is sold by the piece They are usually cut from the breast, ½ to one inch thick

NIAGARA BRIDGE

Structure Over Gorge Safe From Ice Jams

ALMOST directly on the site of the famous Falls View Bridge at Niagara Falls, which was destroyed by an ice jam in 1938, a new bridge was started in June This new $4,000,000 project will have a main arch span of 950 feet across Niagara Gorge at a point about 2000 feet below the American Falls It will be the longest bridge of its type in America, the next longest being the Hendrick Hudson Bridge across the Harlem River in New York City It will have one graceful structural arc across the Gorge and will have no superstructure other than the railings. There will be a wide promenade on the southern edge of the double roadway, giving a full view of both the American and Horseshoe Falls Traffic will be carried by two 22-foot roadways separated by a mall Of particular importance is the fact that the foundations for the new structure, in the face of the Gorge cliffs, will be high above any possible ice-jam of the future

CARBON IN CEMENT

Colloidal Carbon as a Grinding Aid in Portland Cement Manufacture

COLLOIDAL carbon, commonly known as carbon black, is an effective grinding aid in the manufacture of Portland cement, according to the results of research carried out by the Columbian Carbon Company's Industrial Fellowship at Mellon Institute, Pittsburgh

The report of this investigation discloses that a carbon dosage as low as 0 32 percent on the clinker increases the fineness of the cement by 30 percent when the time of grinding is constant, and that the same carbon dosage decreases the grinding time by 28 percent when the grinding is to run constant fineness With a 1 percent carbon dosage, these improvements become 50 percent and 34 percent, respectively In terms of power saving and increased output these results are of practical significance The cements prepared with carbon present as a grinding aid, compared to the controls, showed improved strength properties in tensile and compression tests on mortars These benefits are attributed in the main to the increased fineness of the cement, although there is evidence that the carbon, per se, is contributory The use of carbon in dosages up to 1 percent does not alter appreciably such standard properties of Portland cement as consistency, setting time, and

Architect's drawing on photo shows how new Niagara Bridge will appear

soundness, color excepted, and has no noticeable effect on the resistance of cement mortars to freezing and thawing treatment

PLYWOOD PANELS

Large Size, Seamless, Easy to Erect

COMPOSITE plywood panels in room sizes up to eight feet by 20 feet and faced with fabric have been announced by the Speedwall Company The giant size of these panels eliminates joints Ordinarily, one board makes a room wall, while


One-piece panel

four of them make a whole room Thus this Jumbo Speedwall, as it is called, saves erection time, and eliminates joint making on the job and the possibility of the development of cracks later on

This Jumbo Speedwall is made up of standard grade, water-resistant, Douglas fir plywood panels, hot-press "welded" together with synthetic resin glues Surfaces to be decorated are sealed and "dressed" with a strong woven fabric, such as is often applied by fine decorators over many different types of surfaces The special adhesive with which this fabric is applied also provides fire resistance and a moisture barrier for the wall when it is used

PLATINUM

Metal Leaf Used for Decorating Building Entrance

THE first application of platinum leaf for building decoration was completed recently on the outer vestibule ceiling of the 67 Wall Street Building, in New York City

Platinum leaf—latest product of the ancient art of gold beating—is beaten down to a thickness which requires a stack of 250,000 leaves to measure an inch in height Yet, when applied to a surface, the leaf provides a metallic effect with all the rich color and beauty of platinum The metallic leaf was selected for the entrance because of its brightness, tarnish resistance, and freedom from discoloration by atmospheric conditions

Platinum leaf has been available for several years for outdoor signs, interior decoration, bookbinding, and many other decorative uses

QUICK-FREEZE

Machine For Home Freezes Foods

AMERICA'S first sub-zero locker box for the home has been named Deep-Freeze It is being built in one-barrel and two-barrel capacities and incorporates certain innovations in refrigeration

Conventional refrigerators pull against a vacuum but the Deep-Freeze unit actually operates on the pressure side Tests have shown, it is claimed, that the Deep-Freeze unit requires considerably less current to produce zero cold than does conventional equipment

The cooling element is unique It consists of a double wall cylinder of heavy steel which serves both as the food box and as the cooling element Freon refrigerant is circulated in the space between the cylinder walls, hence the entire usable interior space is surrounded by a refrigerant

This new Deep-Freeze food locker was developed by W L Morrison The one barrel capacity will be more generally used by urban families while the two barrel capac-


Quick-freezer for the home

ity might be used by farmers to provide long-term cold-storage facilities for meat and other fresh foods, including vegetables Sportsmen might use it for quick freezing of fish and other game

CELLOPHANE CEMENT

A NEW Cellophane cement adaptable to food packaging has been placed on the market by Carmen Products It is described as transparent, tasteless, and odorless, moisture-proof, and resistant to acids and alkalis

RUBBER ROAD ROLLERS

THE ponderous iron road roller with its clanking, barrel-like rollers, is being displaced in some types of service by vehicles equipped with pneumatic rubber tires Use of the tires for road rolling has proved the best method of


Multiple pneumatic tires replace the iron barrel of the steam roller

Above: **Three-unit machine for removing chicken feathers.** *Below:* **Making the feathers fly**

obtaining the equivalent action of heavy traffic compaction on road mix and rock asphalt surfaces, tests have shown Developed by The B F. Goodrich Company, the new tires are mounted in series with as many as nine or more to a single vehicle.

TRENCH MORTARS

And Shells Made From Standard Steel Tubing

STANDARD seamless steel tubing can now be used to make trench mortars for the United States Army, according to Captain Daniel J Martin, writing in a recent issue of *Army Ordnance*

Trench mortars are light weapons originally intended to be used by infantry to blast the enemy's trenches They have been so improved that they have become actually light artillery—very effective for blasting out enemy machine-gun positions Of the two types used, the 60-mm mortar weighs but 39 pounds, while the 81-mm mortar weighs, assembled, 134 pounds This latter mortar may be carried, disassembled, by three men

Since trench mortars are smooth-bore weapons and the powder charge is relatively small, Captain Martin explains that both the weapon and the shells it fires may be made of standard tubing From this it is obvious that manufacture of adequate numbers of these weapons can be attained rapidly and easily

CHICKEN PLUCKER

Machine Does Work Ten Times Faster

PLUCKING the family chicken—or the game bird from your autumn hunt—will cease to be a burden if you have a new machine recently put on the market as a commercial product However, since it's designed for mass production, you probably still will find that the old hand method is more economical in the home

Expert hand pickers in the poultry market can pluck about 35 or 40 birds an hour The machine will handle about 250 or 300—with some limitations Tail and wing feathers require manual attention But aside from that the machine will make the feathers fly Actual results in the Schulte Poultry Company in Cleveland largely have confirmed the predictions of the manufacturers that the equipment will revolutionize the industry

Essentially the machine consists of one or more metal drums, each about 2½ feet in diameter Each drum is bristled with rubber tube fingers, thus in effect becoming a cylindrical rubber brush As this revolves rapidly it literally brushes out the feathers.

These flying wet feathers naturally are corrosive to many metals. Further, they tend to stick to the machine as they dry Because of the ease with which it can be cleaned, as well as its resistance to corrosion, the machine is made of Monel. It is manufactured by Mueller Metal Products.—*INCO.*

NON-SKID

Abrasive is Cast Into Metal Stair Treads

SLIP-PROOF stairway treads, which incorporate an abrasive material penetrating the entire thickness of the plate, are a development of the National Bronze and Aluminum Foundry Company This abrasive, which is called Ten-Lox, is cast in the metal in molten form to insure a perfect bond around each particle of the material These stairway plates are cast in any size or thickness and are easily installed on existing surfaces through the use of countersunk screws, bolts, or specially prepared mastics.

Ten-Lox slip-proof stair treads and floor tile are impervious to the action of water, oil, and grease They can be furnished as cast, sand blasted, scratch brushed, or polished, with or without nosing

TIMBER PROTECTION

Impregnation of Timber With Arsenic Salts, New Swedish Method

MANY attempts have been made to find suitable means of protecting timber against rot and insects Painting is, of course, the most common but, being only a surface preparation, it does not prevent the body of the timber from taking up moisture, and therefore rot gradually appears even in painted wood

The effective components of a new Swedish impregnation method are certain arsenic compounds. The method has been developed by the Boliden Mining Company, in Stockholm, which obtains large quantities of arsenic as a by-product in the smelting of copper ore from its mines in northern Sweden

The impregnation liquid used consists of a solution of various salts, including arsenic After these salts have entered the timber, a chemical process takes place, with the co-operation of certain easily oxidized substances in the wood itself. The final result of this chemical process is the production of zinc arsenate and chromic arsenate, which become inseparably fixed in the wood, and constitute the effective elements against attacks of decay or insects.

Arsenic-impregnated timber is

said to retain its mechanical qualities. It takes on a soft green color with a slight shade of brown, which is sufficiently strong to render painting unnecessary if the timber is used in buildings Another advantage is that the timber does not catch fire as easily, and burns less quickly than unimpregnated boards, thus contributing to damage reduction in case of fire

The new method is said to compare very favorably in cost with other methods In the Scandinavian countries, arsenic-impregnated timber at present is being used increasingly for various kinds of out-door purposes, including quay and other under-water constructions Twelve impregnation plants in various parts of Sweden are employing the method, in addition to some in Norway and Denmark —*Holger Lundbergh*

PIPE PROTECTION

Oil Pipes Covered with Cellulose Sheet

EXPERIMENTS have been conducted in the Texas oil fields for more than six years by a major pipe-line company in an effort to find a protective coating material that would be physically and economically satisfactory for use on oil lines From the many materials tested, there has emerged one shield of considerable promise· Pyralin sheeting

In one test case, clear, transparent Pyralin 005 of an inch thick was used and in the other, black Pyralin 008 of an inch thick A coat of hot asphalt was applied to a six-inch diameter pipe which was then wrapped with the Pyralin shield The line was replaced in soil known to be highly corrosive and inspected intermittently over a period of three years.

Final inspection of the two sections showed that both the clear and the black Pyralin had remained free from chemical or physical change Considering that a price differential favored the black material, it was decided to select that color for future work, and to use .01 of an inch thick material as a safeguard against breakage from clods and rocks in the trench bottom.

Pyralin is not appreciably affected when exposed to damp atmospheres or immersed in water, reports *The Du Pont Magazine.* Under normal conditions it will absorb only about 3 percent of its weight. In addition, it is only slightly affected by weak acids and weak alkalies Experiments show that it remains smooth and hard when underground; that when earth surrounding the pipe contracts due to change in temperature, it slips away, leaving the wrapping unharmed. The material

has the required rigidity and yet is pliable enough to permit easy application

To obtain a tight fit around obstacles such as collars and girth welds, the sheets are first softened in a liquid solution of one part ethyl acetate, three parts alcohol, and four parts water The Pyralin expands, when softened, but upon drying shrinks a greater amount, making possible a tight form fit on sections of irregular shape

HEREDITY RULES

Despite Science's Attempts To Change a Fly

FIFTEEN years ago a normal fruit fly of the species Drosophila was mated to a female with degenerate wings From their descendants a similar pair were chosen and mated, the male normal in every respect, the female with vestigial wings This procedure has been repeated for 300 generations, the equivalent of 9000 years of human life, yet today the genes that produce normal wings in this fly are still functioning, stubbornly refusing to be bred out of existence or changed in their action —*The Industrial Bulletin* of Arthur D. Little, Inc.

MOTORIZED TILLER

Machine Shreds Soil in Seed Bed Preparation

A NEW motorized garden tiller, which is steered by handles like an

Left: **Shredding garden soil with the motorized tiller.** *Above:* **Rotating tines that do the work**

ordinary plow but which is completely motorized, is the product of the Ariens Company. Ariens Tillers are used by truck gardeners, greenhouse men, city parks, nurseries, and the like, for they are ideally suited for these applications as well as for small farms.

A particular feature of this tiller is the group of rotating, sharply pointed tines under the hood at the rear of the machine These tines literally tear the soil to shreds, thus making it unnecessary to plow and then to disk and perhaps to harrow a seed bed being prepared The machine operates equally well in tall weeds which it rips up by the roots It is particularly adaptable to the job of tilling soil between shrubs or in other restricted or confined spaces

GLOWING CARPETS

Carpet Fluoresces; Lamp Activates It

COINCIDENTALLY, there comes to our desk news of two complementary developments. The first concerns a new "magic carpet" which glows in the dark under the invisible "light" from ultra-violet ray lamps The other concerns development of a lamp for activating such carpets, making them glow, in such locations as the aisles of darkened theaters

The new carpet was announced by H E. Millson of the Calco Chemical Division of the American Cyanamid Company He explains that the carpet is dyed with special dyes which appear quite ordinary in daylight but glow softly with various colors under invisible ultra-violet rays Hence, it will be of value in providing an extra safety feature in theaters

The Continental Lithograph Corporation announces the other

development — new Conti - Glo Black Lights which were designed specifically for this use. Formerly black light equipment gave spotty results whereas the beam pattern of the new one is very long, narrow, and exceedingly sharp in cut-off at the edges

DRINKING WATER

Need For Better Water Pipe Inspections

RESIDENTS of Joliet, Illinois, a few months ago found their drinking water strangely flavored with beer and soda-water flavors The reason was a cross connection between city water and a private supply in two breweries and two soft-drink bottling places which permitted back-flow into the city mains

Reporting this occurrence to the trade journal, *Plumbing and Heating Business*, A R McGonegal, formerly plumbing inspector for the District of Columbia, points out that "poisonous solutions such as acid copper-cleaning compounds might have been drawn into the mains by a drop in pressure just as easily as beer"

Renovation of water piping in industrial plants all over the country is a health necessity, according to recent reports from public health engineers Their reports refer to conditions during normal times but the situation probably needs attention more urgently than ever, now that industrial production is being speeded up for national defense, with consequent extra loads on plumbing and piping

FEEDER ROADS

Surfaced with Cement and Soil Mixture

MOTORING around the country, you soon may be riding on a "dirt" road made with cement! Already, in 29 different states, sections of this new type of road have been installed, using a method of construction which engineers thought impossible only a few years ago, according to James Stokley of *Science Service*. The new method is being used on feeder sections of roads where the $20,000 to $40,000 per mile for concrete construction is not justified

For years, specifications for making concrete had prohibited use of material containing more than 5 percent of dirt However, some experiments in South Carolina in 1933 and 1934 indicated that under some conditions it might work Under the direction of Frank T Sheets, then director of the development department of the Portland Cement Association, and Miles D Catton, studies were conducted and formulas and tables were developed to guide future builders

Above. **Spreading cement for resurfacing a dirt road.** ***Below.*** **Cutting the cement into the dirt**

In building a soil-cement road the first step is to take samples of the soil and test them These tests show the proportions of cement and water to be used Road work begins with a scarification of the old road to a depth of about six inches with rake-like devices hauled by a tractor A disk harrow then pulverizes the surface Portland cement in pre-determined amounts is then spread over the road and this is cut into the loose surface by disking and with gang plows drawn by tractors Water is then added under pressure in carefully controlled amounts, and harrows, plows or cultivators again go to work. The surface is then packed down, graded, and rolled. After slow drying for about a week, the road is opened to traffic, though about a month is required for the road to "season." Sometimes a thin asphalt layer can be applied to give the proper riding surface, though this is not necessary as a protection.

FLOWER POISON

Cut Flowers Keep Best In Absence of Fruit

BY rule of thumb, florists have thought for years that cut flowers would keep better at a refrigerator temperature of 50 degrees Actually, they keep better at a near zero temperature, though florists who stored cut flowers at that temperature usually found that the flowers would not keep The Department of Agriculture has found the "nigger in the wood pile"

When the florists stored carnations at just above freezing, it usually happened that storage space was in a warehouse that also contained apples in storage Ethylene gas is given off by apples in storage and ethylene gas is poisonous to flowers That is true even when minute quantities of the gas are present as in the case where flowers are stored in a warehouse which formerly contained apples

GIANT ARC

Quenched by Compressed Air Blast

A POWERFUL blast of air racing six times faster than a tropical hurricane recently blew out an electric arc powerful enough to light for an instant all the lamps in Chicago

Surging with 150 pounds pressure from a container not much larger than an automobile gas tank, at a speed of 600 miles an hour, the gust of compressed air extinguished an arc of one and one half million kilovolt-amperes in approximately one one-hundred-and-twentieth of a second Only a slight puff of smoke trailed off as a reminder of the once powerful arc.

Executives and engineers of electric power, industrial, and transportation companies from all over the country witnessed this unique demonstration of a newly developed compressed-air circuit breaker at the East Pittsburgh works of the Westinghouse Electric & Manufacturing Company. L. R. Ludwig, manager of the company's air circuit breaker engineering department, said this test

represented the greatest amount of power ever interrupted by a 15,000-volt commercial breaker operating in air.

One of the functions of a circuit breaker can be likened to a fuse on a power system to open the circuit in case of trouble on the line and prevent its reaching the power house. The other is that of a disconnect, comparable to the wall switch at home, which enables the power engineer to open and close power circuits at will

Essential parts of the breaker include a tank of compressed air at a pressure of 150 pounds per square inch, valves and pistons to operate the air mechanisms, contacts, and arc chutes or fan-shaped interrupting chambers All of this mechanism is interlinked mechanically and takes up no more space than a household refrigerator

The new circuit breaker quenches in a few inches of space an arc that theoretically would have to be pulled out some 40 feet to be extinguished in ordinary air

WATER - SOLUBLE

New Waxes are First Completely Water Soluble

Two recently-introduced products should be tempting to experimenters interested in testing each new kind of substance in the hope of finding distinctive properties to impart to existing articles One of these substances, reports *The Industrial Bulletin* of Arthur D Little, Inc , is physically like petrolatum and the other resembles a wax of 125 degrees melting point, but both have solubility properties that are unique. They are the first waxes completely soluble in water, forming solutions as transparent as water itself While readily soluble in benzene and toluene, the acetates, and acetone, they are not appreciably soluble in naphtha or other petroleum products, or in turpentine, waxes, or fats Odor and taste are slight, and preliminary tests on animals indicate that these products are harmless, at least when applied externally.

The waxy or greasy feel suggests slip or lubricating action, for uses where actual greases are not wanted. For these and other applications they can be applied as clear water solutions

The producers, Carbide and Carbon Chemicals Corporation, suggest the soft form as a plasticizer for casein, gelatine, or glue; in

various binding and film-forming applications, as a lubricant for rubber; as a softener for belt-dressings; and as an ingredient of air-scrubbing liquid, in addition to cosmetic application in creams, lotions, and hair preparations. The hard form has binding properties applicable to films, and its surface activity favors suspension of pigments and lakes. This combination of pigment-holding and binding properties offers possibilities for water-soluble, temporary marking crayons and paints, and even for calcimines, grease-proofings, and dressings Many other kinds of uses will undoubtedly be discovered by experimentation

ENAMEL REMOVER

Non-Caustic, Floats off the Surface

An opaque liquid about the color of cream, and called Metastrip, strips baked enamels, varnishes, lacquers, paints, and even the latest synthetic finishes from all kinds of metals by a simple emulsifying action This product of Surface Finishing Products Company contains no caustics, yet it floats the finished surface away from the metal in about two minutes or less. If the surface finish remains in the solution, it breaks up into small particles and stays in suspension.

No special equipment is required for using this agent Metastrip is maintained at a heat of about 190 degrees to 213 degrees, Fahrenheit, and the work is simply immersed in it When removed in about two minutes, the metal has a clean, bright surface

Metastrip is made in two strengths, single and double For average work the single is recommended.

HOLDING TOOL

Magnetic Holder For Small Parts in Production

Adaptation of the principle of the magnetic chuck to a new magnetic tool has been made by Brown & Sharpe Manufacturing Company. This tool, which seems merely a block of metal with a knurled wheel at one end, constitutes a holder of very small magnetic parts which would be distorted or marred in some way if held by the usual vise. Iron or steel work wide enough to span the narrow insert in the top of the block can be held firmly on

it for testing, inspection, and hand operation.

The knurled wheel revolves a magnet inside the block In one position the magnetic flux moves only within the body of the block When the wheel is turned in the "on" position, the polarity of the

magnetic flux is so changed that one field passes up and over the insert in the top of the block, continuing its circuit through the "work" The opposite field of flux passes downward and through the conductive surface on which the block rests so that the block is held as firmly as though in a vise, and it, in turn, holds the work firmly on top

CULT SNAKES

Why Cultists Prefer Copperheads to Rattlers

COPPERHEAD snakes are less deadly than rattlesnakes, water moccasins, and coral snakes This may explain why followers of the Holiness religious cult in Georgia have been able to handle copperheads in their church rites with apparently few fatalities

The bite of the coral snake is very dangerous because the venom of this reptile attacks the nerve centers The venom of rattlesnakes, moccasins, and copperheads, on the other hand, destroys red blood cells and breaks down the walls of the blood vessels Serious as this condition is, it takes a little longer period before it becomes fatal, giving a chance for the victim's recuperative powers and medical aid to overcome the effect of the snake venom.

Copperheads are very dangerous and there are records of deaths from the bite of this snake, but such deaths are not common The reasons why the copperhead is less dangerous than the rattler are that the copperhead has shorter fangs, less virulent venom, and, because of its smaller size, injects a smaller amount of poison into a bite.

The habits of the copperhead may also have helped to protect those who handled it in religious rites. This snake is very quiet, seldom striking unless very definitely annoyed or attacked.—*Science Service.*

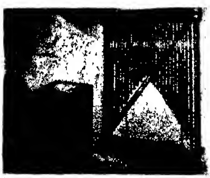
RADIO FIRE-TRUCKS

IF A fire department has no quick means of calling for additional help, or if it is unable to notify the apparatus of an error made in the location of a fire and the trucks have to make an unnecessary run before finding this out, then the department is not utilizing its apparatus with the greatest efficiency If the department cannot send apparatus back to the station when it is found that they are not needed, or if it cannot shift equipment and men from fire to fire, the department may be said to be operating at lower than its maximum efficiency Through the increased use of the radio, this condition is being steadily improved Two-way radio has made possible the operation of a department as a closely co-ordinated, yet flexible, unit, free from confusion and lost motion —*Fire Engineering*

CHIME-CARILLON

Gives Impression of Costly Belfry Carillon

WHAT is said to be the world's most accurately tuned carillon is now being produced by the Sundt Engineering Company This instru-



ment is an amplified, 25-chime, 37-note, keyboard-operated, tubular, chime-carillon The keyboard is played like that of a piano Large outdoor speakers mounted in a church belfry give the impression of a large and costly bell carillon.

The Sundt carillon is tuned to

such close accuracy that it eliminates the out-of-tune sound so frequently occurring in outdoor carillons when two or more notes are played together. Special electric pick-ups on each chime pick up the deep sub-octave bell notes which are amplified separately. In this way the range is extended a full octave. Microphones pick up the usual chime note. The two are blended by foot pedals to obtain unusual "distance" effects and variations.

Although the total weight of the Sundt carillon is only 600 pounds, the deepest note it produces equals the tone produced by a bell of 12,500 pounds.

HYDRAULIC

Coal Mining With a Pressure Tube "Explosive"

HYDRAULIC pressure is now being used in coal mining to take the place of explosives usually used. Results of tests made over a period of about two years have been promising enough to warrant the du Pont Company placing this process on the market in a limited way.

The hydraulic mining process is basically simple. After the usual holes are drilled in the coal face a special tube, closed at the end, is inserted. The protruding end is connected through an electrically driven pump to a storage tank containing a special oil. The pump drives the oil under very high pressure into the tube inserted in the hole, the tube expands under the great pressure, and the coal face is broken down.

In other words, the pressure exerted causes such expansion and resultant enlargement in diameter of

Inserting a hydraulic mining tube in face of a coal vein

Close-up of the mining tube that expands under pressure

the tube that the coal is broken free along its natural parting lines, without explosion, flame, or the evolution of fumes or smoke.

The mining tube itself is of rubber with a relatively small hole and a thick wall, and is covered with a steel braid that both protects it and prevents its rupture.

Experimental work on this new method was conducted by the du Pont Company in a number of mining areas. The most extensive tests have been made at the New Monarch Mine of the Consolidated Coal Company at Herrin, Illinois.

OIL

U-V Rays Detect It In Mud From Wells

NEW aid to rotary drillers in finding oil-bearing formations is the ultra-violet ray. Inventors say it detects instantly minute quantities of oil invisible to the naked eye in drilling muds.

After mud has travelled down through the hollow drill pipe, passing out through the drill, bringing cuttings back to the surface, a beam of ultra-violet rays is focused upon it. The tiny particles of oil, if present, become fluorescent.

WARSHIP SPEED

Italians Test Unfinished Ships

MUCH has been written in recent years of the success of the Italian Navy in building enormous speed into Italian warships. Almost invariably trials of cruisers and destroyers show speeds several knots higher than those in comparable vessels of other navies. It is to be wondered if these high speeds are all to be explained as may be that of the 10,000-ton cruiser, *Zara*. We

quote the following paragraph from *Engineering* (London) regarding the trials of that ship.

"A photograph from the air of the 10,000-ton cruiser *Zara* on trials showed that she was minus the whole of her main armament, including not only the guns, but the turrets themselves In such circumstances, it is not difficult to attain remarkable trial speeds, but the assumption is reasonable that another year, at least, would be required before the vessel could be regarded as an efficient fighting unit, fit to take part in any combined naval operations."

COPPER PLATING

Immersion Process Is Simple, Economical

OFTEN a coating of copper is desired on metal quickly and more economically than is ordinarily obtainable by electro-plating Use of Cuprodine solves the problem This is a powdered chemical which is employed in much the same manner as ordinary copper salts but produces a denser, more adherent, and more lustrous coating The process is particularly adaptable to the job of coating round wire to reduce the wear on drawing dies

The Cuprodine process is simple The surface to be copper coated is first pickled and then rinsed It is then immersed in the Cuprodine solution until the coating is completed, which may require from 10 seconds to two minutes depending upon the nature of the steel or the thickness of the coating desired

TREES

Personal Histories Suggested

THE life history of a single tree may not seem particularly important, yet such a history, if complete in many details, would make not only an interesting record for future generations but conceivably might supply scientists of the future with facts regarding tree growth that would be valuable to them.

Professor Ralph G Unger, of the New York State College of Forestry, at Syracuse University, recently suggested that such personal histories of trees might be made by many persons. Under his plan, the common and scientific names of a tree—perhaps one planted for

shade purposes in a yard—would be recorded: other facts would include the origin of the tree, the date and age when planted, and by whom Thereafter, an annual record would be kept of the diameter in inches, height in feet, crown spread, disease and insect attacks, any injuries, extent of seed crop, and similar details These records would be handed down from generation to generation in a family, or from owner to owner

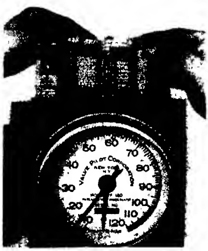
Professor Unger urges adoption of this plan because, as he says, "our historical trees are disappearing rapidly . . . and the young tree of today may become important historically in the future."

LOCOMOTIVE RECORDER

Checks Engineer's Alertness to Signals

To provide railroad officials with a graphic record of their engineers' alertness to running signals, Valve Pilot Corporation of New York City has developed an Automatic Train Signal Recorder

Where railways are equipped with automatic block signals, a



train will stop automatically if it runs past a caution light. By moving the so-called forestalling lever, the engineer forestalls this automatic application of the brakes and then proceeds in accordance with the instructions flashed by the signal Ordinarily his superiors have no record of this action, but if the locomotive is fitted with an Automatic Train Signal Recorder, a record is made automatically each time the engineer forestalls

The instrument consists of a pencil attached to the armature of an electromagnet. When the engineman forestalls, a warning whistle in the cab sounds off. The rush of air to the whistle closes an electro-pneumatic switch which sets up an electric current in the magnet and causes a pencil on the armature to make a mark on a paper tape.

The Automatic Train Signal Recorder is housed in the Loco Valve Pilot instrument which indicates and records speed and cut-off control. From one unit, therefore, there is obtained a record of the engineer's attention to three important operating factors—efficiency, speed, and safety.

FIRE ALARM

Self-Contained Unit Rings a Loud Gong

A DEVICE no larger than the hand and employing mercury as an activating agent conceivably might save many of the 10,000 lives that are annually sacrificed through fires in American homes

The life-saving invention is an automatic fire alarm, complete in itself, which sounds its warning almost immediately upon the outbreak of any fire in the area which it guards The alarm functions through the thermostatic action of a tiny mercury switch When the temperature about it reaches a degree which indicates the presence of fire, the mercury switch sets off a gong of sufficient volume to arouse the household, even from the deepest sleep

Since the new alarm is so small in size, it can be hung inconspicuously on walls or laid upon dresser or table—and the price has been made sufficiently low that the average family can place several units in danger spots throughout the home without any strain on the budget

LABORATORY RUBBER

Another, of Superior Quality, Added to List

THE newest of the synthetic rubbers, Chemigum, has just been announced by Goodyear as a result of several years research. A new plant having an initial capacity of 10,000 pounds per day is being installed at Akron

Chemigum is derived from petroleum through a cracking process, and tires made of it are said to give superior performance to those made of German Buna. In

fact, the manufacturer claims that such tires are equal to those of natural rubber. Like other artificial rubber, however, Chemigum at present costs more than natural crude rubber Nevertheless, its increased tensile strength, resistance to aging, abrasion, and oils, and the fact that it may be processed more easily than Buna, make it important industrially It also has possibilities for blending with natural rubber, so that it might help in an emergency to eke out slender supplies of the natural product

SAPPHIRES

War Cuts Down Supply For Industry

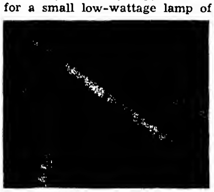
SYNTHETIC sapphires, important for use in jewelled watches and many industrial instruments, are becoming scarce, as we have had to import them from Switzerland, France, and Germany

These gem stones have been made since 1902 by the Verneuil process which fuses alumina The globule which is obtained is split and sliced into thousands of tiny jewels Those used in watches are of small diameter and almost paper thin. The price of these ranges downward to about one and one-half cents each

TUBULAR LIGHT

Smaller Fluorescent Tubes For Restricted Spaces

WITH fluorescent lamps becoming more popular every day, the need for a small low-wattage lamp of



this type for use in limited space has been filled by the production of one only nine inches long. This new lamp is of six-watt capacity, is available in two colors—daylight and white—and sells for $1.15. It is expected to find applications in illuminating business machines, curved showcases, and airplane cabins, in bed lamps and the like.

Conducted by A. D. RATHBORNE, IV

INTEREST IN FIREARMS is traditional with American men, fishing tackle is a requisite of one of the world's oldest occupations Scientific development of guns and tackle, in the use of which millions yearly find sport and recreation, fathers this monthly department which welcomes correspondence from its readers

Strange Guns in Strange Places

In 1855, General William Walker, one of America's most meteoric soldiers of fortune, simultaneously reached the ripe old age of 32 and the shores of Lake Nicaragua, in the country of that name With his "expeditionary" force of 66 men, he appropriated a boat from The Accessory Transit Company, a Cornelius Vanderbilt-controlled freight and passenger line, captured the key city of Granada, and made himself master of Nicaragua For five years his star alternately flared and dimmed It was completely extinguished with his execution in 1860, but the name of William Walker was forever engraved in Nicaragua's history, and elsewhere, as will be seen

Uprisings, rebellions, punctuated by short periods of quiet, beset the little country until 1927, when President Coolidge's emissary, Colonel Henry L Stimson, brought peace to the rival parties Government troops and rebels were both disarmed under the treaty, which provided $10 Nicaraguan money and an honorable discharge to each officer or soldier who surrendered anything that would shoot The U S Marines had charge of this collection of arms, of which there were thousands They consisted of ancient Spanish brass cannon, modern Thompson sub-machine guns which were in the hands of Nicaraguan rebels before our Marines ever saw them, flintlocks, cap-and-ball revolvers, and modern Springfields Where all the guns came from, no one knew, but among them were collectors' pieces by the bull-cart load A request was made that such arms be saved, either for an American museum or for the Nicaraguan National Museum It was denied and three box-car loads of surrendered arms were destroyed under American supervision.

A long, thin echo of the American soldier of fortune, General William Walker, bounced down the ages, trickled through the destruction of Nicaraguan arms, to reach, in 1940, the ears of Charles Edward Chapel, eminent gun collector and author, in California. Chapel visited a brother gun collector who showed him a Colt Model 1848 Pocket Revolver, sometimes called the "Baby Dragoon" Model This was a caliber .31, 5-shot, percussion (cap-and-ball) revolver with a standard 4-inch barrel, worth about $25 in good condition, about $37 in what collectors call "fine" condition As antiques go, it was no show piece, but what attracted Chapel's attention was that, in addition to the usual markings, the barrel was engraved with the name "William Walker"

"My grandfather," said the collector, in response to Chapel's question, "whose name was Walker, carried it in an inside pocket as a personal weapon during the Civil War"

Chapel grinned, asked his friend what he knew of Nicaraguan history

Courtesy Colt's Patent Firearms Mfg Co
"Baby Dragoon"

Under cross-examination the collector broke down, admitted he had bought the gun from a dealer and that the ancestral story was pure hokum Then Chapel told his friend a bit of the gun's history and tried to buy it, but the collector refused to sell, even though there are plenty on the market like it—like it save for the engraved name, "William Walker"

"How do you happen to know so much about this particular gun?" asked the collector.

Replied Chapel "I was a lieutenant in the 5th Regiment of Marines, on expeditionary duty in Nicaragua I saw that engraved Colt at that time It was I who made the request to save the collecors' pieces, and when it was denied, I was ordered to take my guard detail and the three box-car loads of guns to Managua, where the arms were burned"

Was that 1848 Colt engraved "William Walker" as the would-be conqueror's personal gun? Where was it during the 67 years from the filibuster's death to the surrender of Nicaraguan guns in 1927? How did it escape the supposedly all-consuming fires that destroyed the other surrendered arms at Managua. How did it get into the hands of an American dealer in antique arms? These questions may never be answered, but

they show in part the color and romance of gun collecting. Has anyone else a story about "Strange Guns in Strange Places"?

[Note Charles Edward Chapel retired from active service as 1st Lieutenant in the U S Marines Corps in 1937, after having served in China, Nicaragua, and other points since 1926 His book "Gun Collecting" now has a companion piece, "The Gun Collector's Handbook of Values," both of which are essential to amateur and professional collectors of antique arms A publisher as well as an author, Chapel's latest production is a second printing, limited to 1000 copies, of Charles Winthrop Sawyer's "Firearms in American History—Vol 2—The Revolver, 1800-1911" Sawyer, still regarded as the Dean of American arms historians, wrote and published his first edition in 1911 It sold rapidly and is extremely rare today —*Ed*]

Behind the Trigger Pull

In the intricate science of firearms manufacture, it's little things that count Take, for example, 1/600 or 1/700 of a second which elapses from the moment a shotgun hammer is released by trigger pull until the firing pin detonates the percussion cap Doesn't sound like much, but multiply it by 800,000, the number of tests rounds recently fired by Federal Cartridge Company in a Savage shotgun and you will find that the hammer of that test shotgun was in downward motion a total of 22 minutes, 13 seconds "So what?" you say, for no average shooter will live long enough to fire 800,000 shells Why, that's a box of shells a day for 87 years and 245 days!

So, this When you buy an American-made shotgun, you can be confident the gun will stand up, that it will give you a lifetime of satisfactory service Neither Savage Arms Corporation, nor any other American arms maker expects Mr Average Gunner to burn 800,000 shotgun shells, nor do they anticipate the hammers of their guns will be in action 22 minutes and 13 seconds, but they do expect their products to perform satisfactorily To that end, the arms—rifles, shotguns, handguns—are tested far beyond the potential possibility of their use, and actual firing tests are by no means the only indication of solicitous care in manufacturing processes.

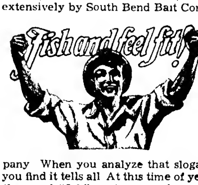
On a recent visit through the Savage plant we passed row after row of assembly work benches, and we noticed that every vise which was holding a gun part was carefully padded to prevent scratching or otherwise damaging the part. We saw hundreds of wheel-equipped racks, built to transport highly polished stocks, shiny gun barrels, or complete guns from one department to another, and every one of these racks was also carefully padded Particularly fine stocks were protected from mars or dirt by soft flannel bags in which they traveled about the plant until they became a part of a beautiful new gun, and then the gun itself went into a bag for safety and protection until final wrapping and shipment All too few gunners comprehend the meticulous care their guns receive before coming into their possession, and sad to relate, all too few owners give their arms as good care as they had in the process of manufacture

Simplification of operating mechanism in modern arms is another of those "little things" which years of scientific study have accomplished. If John Q Gunner had to manipulate an old flintlock, which contained 22 parts, or a muzzle-loading lock of 15 parts, he'd have something to worry about Even the breech-loading hammer gun lock has 17 parts, and certain types of high grade hammerless guns contain from seven to 22 working items in the lock By comparison, the Fox Lock, a Savage Arms product, with its three principal working parts, is simplicity personified There's the coil spring, the one-piece hammer, of which the firing pin is an integral part, and the sear That's all

There are thousands of other examples of scientific advancement in the history of American-made firearms It's a record to be proud of. The American lover of guns, whether for target or game shooting, is the most fortunate gunner in the world, for he has a limitless line of guns from which to choose He has, at his command, a corps of manufacturers, research engineers, scientists, and skilled artisans who persistently endeavor to produce better firearms at moderate cost Best of all, he has, with few minor restrictions, complete freedom of use of his rifles, shotguns, and handguns So, Mr John Q Gunner, when you take your gun afield this fall, just remember that behind the simple action of pulling the trigger lie years of intensive study and research, all to the end that you may better and more thoroughly enjoy your sport

October Bass

As the prize short-short story, we nominate the motto, "Fish and Feel Fit," adopted by The Associated Fishing Tackle Manufacturers, used extensively by South Bend Bait Company When you analyze that slogan, you find it tells all At this time of year the word "fish" conjures up for salt-water anglers visions of striped bass, weakfish, channel bass, bluefish, and



many others. To the fresh water Waltonian, those four letters bring mental pictures of pike, pickerel, walleyes, black bass, and huskie muskies, all of which have been rejuvenated, imbued with new fight by Autumn's cooling waters.

The second word in the slogan isn't really necessary, but it's euphonic, and it provides the suspense angle in this short-short tale "Fish, and . . . ." And what? Ah, those two last words, "Feel Fit." They're the ones that settle the suspense, if any, and provide the logical, truthful, satisfactory, hammer-home-the-point climax.

It's difficult for us to imagine how any two-fisted chap could fish and not feel fit, but we claim those two words form a "logical" climax, because any

OCTOBER BASS
Rod by Heddon
Reel and line by South Bend
Plug by Shakespeare
Bass by Ye Editor!

angler knows that one reason he goes fishing is to feel fit When he accomplishes his purpose, he's proved his point It's a Q E D The same words comprise a "truthful" climax When you toss that plug into the muskie's lair, tinged with reflected colors of the Autumn forest, or when the salt spray crisps your face as that striped bass tries to take your tackle from October into November, you forget every worry you ever knew You *have* to feel fit.

Those two words make a "satisfactory" conclusion to the short-short tale Most of us like happy endings, and what could be more satisfying than to "Feel Fit"? And if it isn't a "hammer-home-the-point" climax, we never saw one! When you think of the phrase, "Feel Fit," don't you vision a Dempsey in his prime, a 4-times champ, Bobby Jones; a Tilden, aceing through the field, an unstoppable Ty Cobb? And aren't they all sort of rolled into one and a part of you,—when you "Feel Fit"? All this is just another way of saying there are still several good weeks of fishing before we pack away the tackle. If you'd like proof, take another look at that October bass. The picture vividly brings to mind the cool of a fall evening, the graceful flight of the plug, the smashing strike . . and then, did I Feel Fit!

Butts

ONE of the surest ways to start an argument among a group of surf fishermen is to ask an apparently innocent question regarding the relative merits of spring butts and club or extension butts for surf rods.

Confirmed spring-butt addicts will rise to the bait, claiming that this type, by far the older form in the comparatively young art of surf casting, permits the surfman to gain greater distance. This, they will insist, is due to the spring action which brings out more of the rod power, and hence throws lead farther

Club-butt adherents will scoff at this theory, holding that this so-called spring action does just the opposite, that it introduces a vibration in the rod which robs the stick of some of its power. Further, they will say that rod power is delivered largely by no more than the top two-thirds of the rod, that if a rod is so constructed that the action extends even as far as the ferrule it will not have the casting qualities of one that is properly proportioned

One of this country's leading craftsmen in the field of hand-made surf rods, Charlie Maltby, has held forth on this subject for long hours with the writer When a cast is made with a spring-butt rod, says Charlie, the entire rod, from tip to butt, approaches the form of a slim letter "S" as casting power is applied Then, as the lead sails seaward, the bend of the butt part of the "S" reacts and causes the tip to vibrate

Here is a field that offers opportunity for study by some scientifically inclined surfman Perhaps one angle of approach would be to take slow-motion pictures of a good surf caster using first a spring-butt rod and then a club-butt stick Analysis of such pictures might reveal facts that would substantiate or disprove theories—*A P P casting for A.D R.IV*

POT-SHOTS At Things New

STOEGER ARMS CORPORATION'S advance information on their 1941 Catalog-Handbook indicates the publication will be most ambitious in Stoeger's long history and will more than ever merit its designation as "The Shooter's Bible" New volume will show 4700 revisions from 1940 edition, as well as replacements for many items made unavailable by changing world conditions Gun tools and gunsmithing section will be one of most comprehensive ever published; hunting clothes, accessories and book section will be larger; over 100 pages will be devoted to gun parts for American guns; ballistics tables have been thoroughly revised As virtually all

prices have changed due to rising costs and governmental taxation for national defense, new figures will be shown here for first time In all, more than 16,000 items, accompanied by 6000 pictures, many in color, are described and priced in the 1941 Stoeger Catalog-Handbook Frankly, we couldn't get along without our annual copy of "The Shooter's Bible," especially when it's only a dollar, and we're sending in our reservation for a copy right now

GRIFFIN & HOWE, INC., announce their new "Zero-Rig Telescope Mount," which is a new and radically simple fixed mount for all standard 'scope sights. Once 'scope is set at zero with Griffin & Howe rig, it remains at zero, regardless of how often sight is dis-

mounted "Zero-Rig" embodies a firmly fitted, square shoulder joint with large, flat-headed screws to hold each bracket arm and 'scope ring in secure contact By removing these two flush-set screws, 'scope and clamps can be lifted from the fixed base to leave top of the rifle clear for aiming with other sights We have descriptive folders

FREE BOOK LISTS We have read and reviewed many interesting and informative books and other publications in the fields of firearms, fishing tackle, natural history Reviews have appeared in Scientific American's "Our Book Corner" and publications have been mentioned in this department under "Books of the Moment" For your convenience, we have prepared lists of the books thus covered, showing titles, authors, prices, and a line or two of explanation. If you'd like one or more of these compilations, drop us a line and specify your desires Only cost is a 3-cent stamp for return postage (Note Gun book list includes "History of Colt Revolvers," by Haven and Belden, sponsored by Colt's Patent Firearms Manufacturing Company, and hot off the press September first)

Conducted by JACOB DESCHIN, A.R.P.S.

Letting George Do It

"POP" goes another myth—the degeneracy of the photo-finishing plants. There is widely current the time-worn notion, frequently based on fact, that he who seeks the "drug store" finisher deserves what he gets sluggish work for sluggard workers But the truth is that there are good photo-finishers and there are bad ones, just as there are good and bad photographers and good and bad anything else

One corner of the film drying room in the Pavelle Laboratories

In order to obtain a cross-section picture of photo-finishing plants in general, we recently interviewed Leo S Pavelle, head of Pavelle Laboratories, Inc, an organization offering specialized plus routine service, and Nat Derfler, head of Royaltone, Inc, which serves the routine snapshooter class In the latter type of finisher, all work in the plant is geared to mass production—prints in seven hours—whereas the former stresses quality rather than the time element Both types strive to do the best possible work under the conditions imposed

A few statistics may provide some index to the volume and type of work turned out by the two kinds of finishers Mr Pavelle places the yearly average of film rolls processed at his plant at about 150,000, while Mr Derfler's place develops about 250,000 annually At Pavelle's, 75 percent of the film is in the 35mm class, while at Royaltone all but a small percentage are the usual amateur sizes other than 35mm The latter averages 2,500,000 prints a year, 80 percent of the total printing business being contact, 20 percent enlarging At Pavelle's, the greater percentage of the printing business calls for enlargements, a good portion of the orders being for postcard size enlargements from 35mm negatives.

A visit to the Royaltone plant was an eye-opener, in view of the stories we have been hearing about those awful "drug store" finishers The 90-gallon temperature-controlled film developing tanks are continually being replenished to keep the solution top-notch, the tank is completely refilled every 16,000 rolls Rinsing is done in a tank through which fresh water is running continuously. Fixing is done in two successive baths, the first a strong bath, which is thrown away and a new bath made every 4000 rolls, and the second a weaker hypo bath, which is changed every 12,000 rolls Finally, the film goes through two washes Drying is done in special rooms equipped with fans to circulate heated air Printing is not the slapdash affair many persons have been led to believe it is. Each printing machine operator has before him a selection of six different grades of contact paper, from which he selects the proper grade to fit individual negatives Also, timing is not the same for all negatives but is proportionate to the density of individual negatives When the print reaches the developed stage it is inspected by the operator there, who may reject a print which has been printed for an insufficient period or on the wrong grade of paper It is then sent back to the printer for a better print In other words, the photo-finisher of the Royaltone class does just about what the careful worker would do in his own darkroom at home

Maintaining standards of the highest order, the Pavelle plant offers a universal service, making prints ranging from contact to photomural dimensions That the quality of its

Leo S. Pavelle inspecting an exhibiting print in the making

work and the universality of its services has been recognized is shown by the fact that among Pavelle's patrons are departments of the Federal Government, large business concerns, and individual workers all over the world, as well as a mass of amateurs in this country From developing rolls of films for individual workers the Pavelle services go all the way to the preparation of complete photographic exhibits for large manufacturers of cameras, film, and paper

One of the Pavelle plant's major activities is the preparation of enlargements intended for exhibition For this purpose the Exhibition Department was created, in which from 100 to 200 exhibition prints a week

Large trays facilitate handling of prints for exhibition purposes

are turned out, most of them 11" by 14", a good percentage 14" by 17" Mr Pavelle observes that there is a definite trend toward the latter size as the more popular among exhibitors The prints are mounted on the regulation 16" by 20" matts required by salons A wide variety of papers and surfaces are available in this department to match every good negative to the paper best suited to bring out the values and mood of the negative. Most of these prints are selenium or gold-toned Mr Pavelle says that the resulting tone is almost imperceptible but is enough to show a real difference, one of the valued results being the realization of better blacks

One of the features of the Pavelle plant that helps in maintaining quality of service is the Research Group, a skilled staff which has at its disposal complete photographic laboratory testing equipment for testing ever-changing new developments in photography

"As soon as anything new appears on the market that may be utilized photographically, be it a new light source, a new film, a new paper, or a new developer, it is immediately put through an accurate laboratory as well as practical test," Mr. Pavelle says. "Nothing is taken for granted. If the product proves of merit, its properties are carefully evaluated and it is applied, wherever indicated, to the processes used throughout the Laboratories . . One outstanding example of the work accomplished is the compilation of complete sensitometric data for all 35mm films and all popular developers"

The Pavelle plant is the last word in modern high-grade equipment, all developing being done in stainless-steel tanks and all machines automatically controlled to process different types of film for the exact times of development, fixation, and washing as well as at a definite rate of agitation in each solution required for each film type "Ours is perhaps the only still-film laboratory in the world," says Mr Pavelle, "where daily sensitometric tests determine with scientific accuracy the activity of negative developing solutions Our negative developers are kept at a constant developing potential by the addition of replenishing solutions in definite ratio dependent on the number of square feet of film that have been developed Thus all films are invariably developed to a specific gamma in a given period of time"

Paper in Quantity

THE worker who takes advantage of economies in order to keep his photographic costs down, may be interested in the fact that the purchase of printing or enlarging paper in half gross or gross lots will effect a considerable saving Of course, if only a few prints are made occasionally or if the worker likes to do a lot of experimenting with different papers, this may not be appealing But those who have settled down to one paper and who do much printing will find that they can save as much as 20 percent or more by purchasing paper in gross lots rather than in packages of a dozen

Cooling

A SUMMERTIME developing kink that may possibly be out of date by the time this appears in print (though it frequently happens that temperature runs rather high during some days even in the "cold" seasons of the year) comes to us by way of the picnic basket A product known as Icit, a sealed can measuring about four by six by one inches and containing a liquid, is being sold for use in cooling the picnic lunch The can is placed in the lowest ice-cube compartment of the refrigerator the night before the picnic The next day it is frozen solid and is placed in the center of the picnic lunch The use of Icit in photography is obvious The can is placed in the developer tray and, according to the experience of Carlyle Trevelyan, will bring the temperature down to 65 degrees Fah-

Fifth Annual Scientific American
AMATEUR PHOTOGRAPHY CONTEST

[For Complete Contest Rules, See Page 94, August 1940 Scientific American]

OVER $1200 IN PRIZES

36 PRIZES PLUS Three Special Awards

IN this year's contest, prints may be entered in any or all of the three groups listed below, in accordance with the rules. In addition to the seven major prizes and five honorable mentions, there will be three SPECIAL AWARDS that will be accorded to the three outstanding photographs among the 36 prize winners. *These special awards will be given in addition to the regular prizes that the pictures win*

DIVISIONS IN WHICH PRINTS MAY BE ENTERED

Division 1 Human interest, including camera studies of people, animals, and so on. Portraits will be grouped in this division

Division 2 Landscapes, including all scenic views, seascapes, and so on.

Division 3 Action, including all types of photographs in which action is the predominating feature

THE PRIZES

1st. Three $125 LONGINES, Coronation Model, Solid Gold, Men's Wrist Watches.

2nd. Three $85 LONGINES, Presentation Model, Solid Gold, Men's Wrist Watches.

3rd. Three FEDERAL No. 246 Photo Enlargers (List Price $49.50).

4th. Three FEDERAL No. 345 Photo Enlargers (List Price $42.50).

5th. Three PIERCE CHRONOGRAPH Men's Wrist Watches (List Price $19.75).

6th. Three BERMAN-MEYERS Flash Guns complete with case (List price $15).

7th. Three FINK-ROSELIEVE Vaporators (List price $12.50)

HONORABLE MENTION

1st. Three Fink-Roselieve "Hi-Spot" Hollywood type spotlights.

2nd. Three Mimosa Perkino developing tanks.

3rd. Three Raygram Wood-Chrome Tripods.

4th. Three Fink-Roselieve Audible Timers.

5th. Three Fink-Roselieve Satin-Chrome Range Finders.

THREE SPECIAL AWARDS!

Winning pictures in the three divisions will be grouped and judged further to determine which three of them shall be considered as the best in the entire contest To the contestants who entered these three photographs will be presented the following special awards

1st. One No. 715 Weston Exposure Meter (List price $24.)
2nd. One No. 650 Weston Exposure Meter (List price $19.95.)
3rd. One No. 850 Weston Exposure Meter (List price $15.50.)

THE JUDGES.

McClelland Barclay, artist
Ivan Dmitri, artist and photographer
T J Maloney, editor of U. S Camera
Robert Yarnall Richie, photographer

Address all Entries to

Photograph Contest Editor, Scientific American

24 West 40th Street New York, N. Y.

renheit. Mr. Trevelyan says that when he used the method one night, he placed the can in the tray at 7 o'clock, when the temperature fell to 65 degrees, and by 12 o'clock the temperature had risen only six degrees. Naturally, the can has to be taken out of the tray when prints are inserted, but this is a negligible inconvenience considering the advantages

General Electric Contest

EXCELLENT handling of a much photographed subject—the 129-foot stainless-steel symbolic lightning bolt and universe in front of the General Electric Building at the New York World's Fair—brought first prize for George Perry, of New York City, in the first half of the General

First prize, G. E. contest

Electric contest The award was $100 in cash. A similar prize is offered in the second half of the contest for entries received until October 11

Held under the auspices of the Photographic Society of America, the judges consisted of Adolf Fassbender, F.R.P.S., Chairman; Robert W Brown, Morris Germain, A R P S., Carlyle Trevelyan; and Jacob Deschin, A R P S

Color Handbook

A "HANDBOOK OF COLOR," containing a complete description of every type and make of color camera, lighting, equipment, chemical, printer, color film, and so on, will be published by Fotoshop, Inc, in the near future. Copies, at 25 cents each, may be reserved by writing to the Color Department of Fotoshop, Inc, 18 East 42nd Street, New York City The contents will also include laboratory instructions for all color processes, technical data on film, filters, and so on; a basic course in the fundamental principles of color photography, and a book-review supplement. The book will contain four-color illustrations. It will have a moisture-proof cover and spiral

binding, the contents will be cross-indexed with manila separators for ready reference

The Rhyming Publicist

If prose seems inadequate to the task of singing the excellence of one's ware, try poetry, thinks Eleanor F. Brown, of Burke & James, Inc. So once in a while we receive from her such a missile as

"Any day is washday
For the fellow making prints
So here's a brand new washer
That will give the world's best rinse!"

Then she goes on in prose to give particulars concerning the Luxor Water Powered Tank

Another time, snappy, readable prose describing the Watson 35mm camera is preceded by this lilting introduction

"For a candid with color correction,
Other features that really are slick!
Let the Watson be your next selection
It's priced so your purse cannot kick."

Under Water

A trick by which contact printing can be done without drying the negative, is used, we understand, by some old-timers when the necessity for seeing the result speedily is more important than print quality or permanency Glass plates are used After the plate has been fixed and washed, it is placed in clear water A sheet of contact paper is then immersed in the water and placed in contact with the emulsion side of the plate Firm contact is assured by carefully squeegeeing the water out with the fingers. Printing is done by an over-head light We are told that by this method, washing of the print being very brief, the result of a developed plate may be seen on paper within two and one-half minutes

Living Title

A clever photographic idea for a magazine cover was recently reproduced on the cover of the magazine *Vogue*. A model in a bathing suit who was obviously expert at gymnastics was photographed in five poses, each one in imitation of one of the letters of the word Vogue. The five pictures, taken and reproduced in color, appeared at the top in the usual place for the magazine name The main illustration on the cover was a repetition of the V pose except that the model's face was in profile, whereas in the magazine name itself her face was in three-quarter pose

Darkroom Wiseguys

Every camera club probably has one, maybe more. The other day we heard of a chap who was developing some enlargements for perhaps the first or second time. At any rate, he did not know anything about it After focusing the image on the easel, he gave an exposure of a few seconds, purely from guess (a guess based on total ignorance because guessers may often justify their practice on the basis of long experience) and developed the print for one half minute, after which he pulled it out of the developer and slapped it into the fixing bath When someone suggested that it might be a good idea to make a test strip first to determine the required exposure time and furthermore that a half-minute developing time was not sufficient to provide a decent black with the paper he was using, he replied "Maybe it isn't, but that's the way I like to do it." Perfectly silly reply, of course, and we are happy to report that this particular worker has now learned the error of his ways and is beginning to mend them Those of his type who do not are best discouraged from continuing in the game altogether

Boys' Clubs Contest

First prize in the National Historical Photographic Contest held by the Boys' Clubs of America at the New York World's Fair, was awarded recently to Francis Hoesch, 14 years old, Boys' Club of Baltimore, Maryland The picture, "Fort McHenry" (the American flag flying there during an attack by the British in 1814

"Fort McHenry"

was the inspiration for Francis Scott Key's "Star Spangled Banner"), is reproduced here The prize was an all-expense-paid trip to the New York World's Fair, with a stay of one week, and a complete photographic outfit

First Camera in America

Identification of the first camera in America and the first "fast action" camera in the world appears to have been made at long last.

according to an Associated Press dispatch from Hampden Sydney, Virginia The old box-shaped camera left at Hampden Sydney College in 1839 by Dr John William Draper antedates even the one used by Dr Draper at New York University to make the first portrait of a living person The Smithsonian Institution has accepted the camera as the first and will install it among its exhibits

It took eight years of research by the Rev Howard C Cobbs, formerly a professional photographer, to provide the necessary proof Mr Cobbs found final proof in a letter by Dr. Draper addressed to *The Photographic and Fine Art Journal*, published in 1858 In that letter he told of working with sensitive plates before Daguerre's and Talbot's announcements, and of experimenting with a large aperture, short focus lens However, he related that the "first portrait" was made with the help of Daguerre's more sensitive plates and methods

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WHAT'S NEW

In Photographic Equipment

NEW KODAK 35 ($47 50) With coupled range-finder and Kodak Anastigmat Special lens $f/3$ 5 in Kodamatic shutter Range finder of split-field military type, in which two halves of large image are lined up as lens is focused Focusing range 4 feet to infinity Focusing by means of control wheel Lens mount rigid tubular type Shutter settings for time, bulb, 1/10th, 1/25th, 1/50th, 1/100th, 1/200th, plus delayed action Advancing film automatically winds shutter and brings into view small red signal indicating all is ready for next exposure View finder of optical eye-level type, built into range-finder housing Slight shift brings eye from range-finder eyepiece to view-finder eyepiece

RAYGRAM PHOTO COLOR KIT ($1 25) New medium for coloring photographs, transparencies, and lantern slides, devised in laboratories of Joseph Dixon Crucible Co Enables coloring all positive photographic materials without preliminary sizing or final fixing of colors. Claim Layman, not trained in art of coloring, with little practice, can neatly and easily do work heretofore attempted only by professional. Kit includes eight colors and shades

SOLAR TRIPLE SLIDING LENS BOARD ($4 75): Attaches to all models of Solar enlargers except Junior, replacing standard lens board Slides easily back and forth, permitting instant placement of any lens in optical center of enlarger. Measures 9¼ by 2¾ inches Sliding member takes three lenses, allows ⅝-inch clearance at back Board accommodates lenses up to 7¼ inches focal length. Diameter of threaded opening on three lens flanges 1½ inches (38mm) Reducing flanges available at extra cost.

F-R STAINLESS STEEL THERMOMETER ($1): Made of 18-8 stainless steel. Dark blue spirit in glass column shows distinctly against etched calibrations to give accurate readings Scale registers from 40 to 90 degrees, Fahrenheit. Special clip offers wide use with trays and tanks

ELECTRONIC PHOTO TIMER ($12.50) Automatic timing control for contact-printing, enlarging, time exposures, and other photographic darkroom operations Operation simple as ordinary stop watch Operates on both AC and DC, entirely electronic (no springs, no clock, no motor), silent in operation, easily set, instantly reset, always under control, makes possible printing of 1 or 100 identical pictures from same negative Strongly built, finished in gray crackle painted cabinet with engraved Bakelite panel

SUPERFLASH MIDGET PRESS 25 (15 cents) Bayonet base bulb two inches high, output 25,000 lumen seconds and same long-peak characteristics as other Wabash hydronalium wire element bulbs Permits three or four new bulbs to be carried in same space formerly required for standard bulb of 1937 Other features Special construction for use in new "concentrating" reflectors, scientific "even light" shape, double jackets of lens-clear safety coating, patented blue Safety Spot Packed in new ten-bulb Pocket Pack fitting jacket pocket

KALART MODEL F RANGE FINDER ($24; installation, $27 50) Adjustable lens-coupled range finder featured exclusively on Speed Graphic cameras now available for other filmpack and plate cameras Adjustable for all lenses from 10 5 to 30 cm, will focus sharply at all distances from 3½ feet to infinity Installation at Kalart factory Following is list of filmpack and plate cameras to which Model F can now be fitted 6 by 9 cm—Bee Bee, Ihagee, Maximar, Recomar, Linhof, 9 by 12 cm—Avus, Ideal, Ihagee, Maximar, Recomar, Welta, Linhof; 10 by 15 cm—Bergheil, Linhof.

TURRET-HEAD FILMO AUTO MASTER, 16mm ($195) Announced by Bell & Howell as first multi-lens magazine loader in industry, who add "Here is the easiest-to-operate camera in the world—offering instant use of three lenses, automatically positioned view-finders, interchangeable film magazines, and freedom from sprocket threading" Price includes Taylor-Hobson $f/2.7$ lens and view-finder objective. Important features: rotating, three-lens turret, upon which any three lenses may be mounted—wide angle, speed, or telephoto, automatically positioned view-

finders (mounted directly on turret beside each lens is corresponding view-finder objective); "Steady Strap" handle detachable, screwing into tripod socket on bottom of camera, new built-in exposure calculator said to give at a glance correct lens setting for both Kodachrome and black and white film—Kodachrome figures in red, monochrome in black

SUPERFLASH PRESS 50 (18 cents) New size Wabash flash lamp, with 50,000 lumen-second output plus standard Superflash characteristics of split-second synchronization, extra long peak flash, and adaptability for all cameras, Compur or focal plane shutters, and all synchronizers Standard No 2 lamp stepped up from 56,000 to 70,000 lumen seconds, dropped in price to 22 cents

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THE ROUND TABLE

Questions Answered for the Amateur Photographer

Q Can you suggest a method of making glass diffusers?—C. J. K.

A You can make your own glass diffuser by obtaining plain glass squares and scratching parallel lines with a glass cutter Use a ruler as a guide. The closer the lines are to each other, the greater the diffusing effect obtained You might cut one glass with lines 1/16 of an inch apart, and another with lines ⅛ of an inch apart If you wish to use only one glass, space the lines 1/16 of an inch and expose through it for only part of the total exposure time

Q I would like to know what kind of developer and the process to use to make a negative print from a negative film.—E. H. T.

A. This is known as the Paper Negative Process A contact or enlarged print is made from the negative in the usual way, and the paper print is placed in contact, emulsion to emulsion, with another sheet of print paper. Exposure is made through the back of the positive print just as if it were an ordinary negative A positive print from the paper negative may then be made by placing the paper negative in contact with another sheet of paper Processing and developer are the same as usual. Single-weight paper should be used, although the final positive or negative, whichever is the final result you want to achieve, may be printed on double-weight paper if desired.

Q. I would like to make black and white prints from some of my Kodachrome transparencies. Will you explain the procedure?—R. D. B.

A Make a negative by contact or enlargement, the latter method being preferable because you can then use a colored filter to emphasize or repress certain colors. Slow panchromatic film should be used. The process is

similar to that employed in making ordinary prints. However, the film is much faster and the proper safelight should be used, namely, the green, preferably no light at all. The final paper print is then made in the usual way.

Q. I am using a twin-lens reflex and find that in attempting architectural shots in which it is impossible to photograph from a distance, much vertical distortion occurs. I have wondered whether anyone has devised the use of a prism in front of the lens to correct this condition, the device possibly installed on a vertical axis in a filter mounting.—E. P. G.

A We have not heard of any such device and doubt its usefulness. Cameras of the miniature type are designed for general photographic purposes and are made small and compact for convenience, the resulting negatives usually being enlarged When architectural shots are attempted, the camera is tilted up, correction of the consequent vertical distortion being done under the enlarger by tilting the easel on which the paper lies in the direction opposite to the tilt in the negative Enlargers are now also available that have a tilting negative holder, which facilitates this work

Q Can you recommend a fine quality sensitizing material which can be applied to glass so as to get a good print?—E. C.

A The glass is first coated with the following solution

Gelatin .	42 grains
Potassium bromide	26 "
Distilled water	1 ounce

The gelatin is first allowed to swell in the ounce of water for a full hour. The temperature may then be raised gradually until the gelatin is thoroughly dissolved. While the solution is still warm, add the bromide In a separate dish, prepare a bath of 32 grains of silver nitrate and one ounce of distilled water In the darkroom, by red light, slowly add the silver nitrate solution to the bromide gelatin solution This mixture is then ripened by heat (100 degrees Fahrenheit) for one hour The emulsion is poured into a glass beaker, the latter then being placed in a 110-degree water bath Stir frequently and when ripening is complete, add slowly two or three times as much gelatin as was used originally. When this added gelatin has dissolved, place the beaker in cold running water until the emulsion jells, when it is cut into squares with a toothpick The pieces are then tied up in a cloth bag and suspended in running water to wash for two hours. All this is done in the absence of white light When the washing is complete, the emulsion may be remelted for coating Pour a pool of the warm emulsion in the center of the glass and spread it into the corners with a glass rod bent L shape. When dry, expose, develop in D-72 diluted 1 to 4, and fix and wash as usual.

Our Book Corner

THE BOOK DEPARTMENT of Scientific American is conducted, with the co-operation of the Editors, to make available for you a comprehensive book service. Each month the Editors select and review in these columns new books in a wide range of scientific and technical fields. In addition, they are ready at all times to advise you regarding the best available books on any subject. You are invited to use this service freely. Tell our Book Department what kind of books you want and you will be furnished with a list of available titles, including prices. When inquiring about books, please be specific; remember that we can be of the greatest help only when you tell us just what you are looking for.

YOUR CAREER IN BUSINESS

By Walter Hoving

YOUNGSTERS just entering business will find this discussion enormously helpful. It faces squarely that vital social problem of how to get a job and then how to make a success of it. The author, President of Lord & Taylor, gives the answers to those puzzles faced not only by the youngster but also by many who have long been in business but have become mere cogs. Some chapter headings will indicate scope Business Has Many Facets, Find Out What You've Got—and Use It'; The Thing Called Personality; Apprenticeship, The Square Peg; What's Your Attitude?, The Person Behind The Job, and others equally pertinent. (211 pages, 5¼ by 7½ inches, unillustrated)—$2 10 postpaid.—*F D. M.*

COMPLETE GUIDE FOR THE DEAFENED

By A F Niemoeller

THE ear, kinds of impaired hearing, causes of impaired hearing, colds, catarrh, diet, glands, drugs, diseases, tonsils, teeth, allergy, psychic factors, otosclerosis, heredity, marriage, swimming, noise, shocks—all in regard to hearing; earaches, occupational deafness, ear wax removal, head noises; ear discharges; oils for the ears, hearing tests, audiometers, re-education, lip reading; how to hear the radio, movies, conversation, telephone, lectures; voice culture, organizations for hard of hearing; periodicals, quacks and frauds; books on deafness, personal adjustment—these indicate the scope of this book which deserves a wide appreciation by the 15,000,000 Americans whose hearing is not perfect. (256 pages, 5¼ by 8 inches, one illustration)—$3 10 postpaid.—*A. G L.*

MAKE YOUR PICTURES SING'

By Paul Louis Hexter, A R.P S.

WRITTEN in lively, unpretentious style, this book takes the beginner in photography, as well as those more or less advanced, through the entire photographic procedure Because of its clear language and many illustrations, facts which may have been difficult to grasp are made easily understandable and therefore usable towards the "perfection of technique" that is the aim of Mr. Hexter's book. As a guide to the type of negative the worker should strive for, Mr. Hexter has included in his book an actual negative, from which the reader may make prints or enlargements (6¼ by 9 inches, 188 pages, many illustrations)—$3 10 postpaid —*J D*

TURRET LATHE OPERATOR'S MANUAL

By J. R. Longstreet and W K. Bailey

WAR orders for all manner of guns and ammunition make it imperative that this country have expert lathe operators—more than we have had for years This complete volume is a course in lathe operation, starting with an historical review and proceeding through classifications of turret lathes, elements, care and maintenance, speeds and feeds, and then taking up the grinding and setting of cutters, drilling, reaming, boring, forming, threading Other subjects covered are chucks and holding devices, tooling principles, special tools, estimating Pertinent data are given in a number of tables. (240 pages, 7¼ by 10¼ inches, numerous illustrations)—$2 60 postpaid

—*F D M*

THE AIR AND ITS MYSTERIES

By C M. Botley

IN no sense a text-book, this informal, friendly work treats scientifically the ground that usually is treated in texts Its scope the air, the winds, the clouds, rain, thunderstorms, weather, climate, atmosphere and light, sound, upper atmosphere People who would like to understand the action of the elements will find this elementary book a good place to start (302 pages, 5¼ by 8 inches, 52 illustrations)—$3.10 postpaid.

—*A G I*

LET'S FLY

An ABC of Flying, by Lieutenant Ernest G Vetter

USING the personal pronouns "I" and "you," Lieutenant Vetter gives the illusion that the reader is receiving a course of elementary flight instruction. The course is logical, clear, and in just the right sequence The book will serve two purposes· to give the lay reader an excellent idea of what is involved in learning to fly, and to give the student pilot an admirable guide which he can read again and again,

no matter what formal instruction he may be receiving. The student pilot will find that the text is not only stimulating but technically correct and above all stresses the elements of safety (116 pages, many illustrations)—$1.60 postpaid.—*A. K.*

ELEMENTARY PHOTOGRAPHY

By Gilford G Quarles

A SUBSTANTIAL work "designed to fill the growing need for a text on photography intermediate between very elementary ones and those of an advanced, technical nature," Mr. Quarles' book is thorough and complete. Starting with a discussion of lenses and cameras, the Assistant Professor of Physics at the University of Alabama immediately plunges into the actual photographic process and carries it to completion About half the book is then devoted to the technical side of photography, in which the serious worker will find guidance in improving his results Paper negatives, print toning, print coloring, natural color photography and lantern slides and transparencies are discussed There is a long bibliography and a useful formulary (6¼ by 9¼ inches, 350 pages, photographs and diagrams) — $3 10 postpaid — *J D*

THE PIN-POINT PLANETARIUM

By Armand N. Spitz

FOR each month this book contains a south-facing and a north-facing star chart with constellations You remove each chart, cut some gores in it, curve it, paste it and thus create a kind of concave chart, through which you prink pins for each star indicated Then you hold these concaves against the sky and thus you are "inside" of a really analogous chart, instead of outside and hind side backward as with a celestial globe. This is a relatively easy way to learn the constellations The book also contains constellation facts, a little very elementary astronomy, a list of sky sights (eclipses, planetary positions and happenings) up to 1946, and a glossary (110 pages, 10 by 8 inches, illustrated)—$2 10 postpaid—*A G. I.*

FIREARMS IN AMERICAN HISTORY—VOLUME II—THE REVOLVER, 1800-1911

By Charles Winthrop Sawyer
Reprint Edition by Lt Charles Edward Chapel

IN every part of the English-speaking world, arms engineers, gun collectors, historians, museum curators, history students, and teachers bought and praised Charles Winthrop Sawyer's 1911 edition of this publication as the outstanding text on origin and development of revolvers. The edition sold out rapidly and today it is next to impossible to obtain a copy. The firearms world, therefore, owes a debt of gratitude to Lt. Chapel for undertaking to reprint this valuable and

instructive volume, under exclusive permission of the author and copyright owner This second edition is limited to 1000 copies bound in red cloth with gold stamping and printed from type, not reproduced by off-set or photo-lithography processes. (216 pages, 5½ by 8 inches, 7 plates.)—$4 60 postpaid —*A. D R , IV.*

WOODCRAFT

By Bernard S Mason, Editor, The Camping Magazine

A COMPREHENSIVE book on woodcraft Trail shelters, teepees, bark shelters, beds, duffel, fire-craft, campfire gadgets, axmanship, caches, bark-craft, woodcraft rope and cordage, woodcraft knick-knacks, woodsy furniture and camp fixings, calumets, rawhide, buckskin, horn, feathers, gourds, tin-can-craft, totem poles—these indicate the scope, which is broader than in similar books. The emphasis is heavily on Indian lore and on the practical how to do and make (580 pages, 6 by 9 inches, 294 illustrations)—$2 85 postpaid

THE WORLD UNDER THE SEA

By B. Webster Smith

POPULAR oceanography Introduced by 64 pages of general background matter about oceanographical instruments, the sea bottom, submarine earthquakes and volcanoes, the physics of the sea, currents and tides, this readable book is mainly about life in the sea—marine plants, sponges, jellyfishes, corals, crustaceans, molluscs, starfishes, deep sea fishes, common food fishes, sharks, marine reptiles, mamals, birds (230 pages, 6 by 9 inches, illustrated)—$3 10 postpaid.—*A. G I.*

THE HUNTING RIFLE

By Colonel Townsend Whelen

EXPERT riflemen or mere tyro, the first 15 pages of this book will convince you that it is the finest work of its kind ever published The author's lifetime of practical rifle experience imparts authority to the easy simplicity of his style Practical and semi-technical, it clearly and understandingly covers the fields of elementary ballistics, design, selection, use and marksmanship of the American rifle, often termed "The King of All Weapons" This book is virtually indispensable to those who are learning about guns, invaluable to those who know them (463 pages, 6 by 9 inches, 89 illustrations, index)—$4.85 postpaid. —*A D. R., IV.*

ORGANES ET APPLICATIONS DU VOL ANIMAL

By Paul Amans M.D., Sc.D.

A CONDENSED treatise on the essential mechanical principles of animal flight, written in French. (200 pages, 6 by 9½ inches, 74 illustrations.)—$1.50 postpaid.—*A. G. I.*

The Editors Recommend

Best Sellers in Science

(Revised List)

1. THE COMPLETE GUIDE TO SOILLESS GARDENING — *By Dr. William F Gericke.* The man who invented soilless gardening has at last prepared this comprehensive and authentic guide covering all phases of this fascinating work For amateur and professional **$2 85**

2. GROWING PLANTS WITHOUT SOIL — *By D R Matlin* Plant chemiculture in full detail, plus discussions of plant environment, root-growing substances, cuttings, insect pests, plant food deficiency, planting calendars, related subjects **$2.10**

3. GROWING PLANTS IN NUTRIENT SOLUTIONS — *By Wayne I Turner and Victor M Henry* Slightly more technical, complete data on tank farming, making equipment, mixing solutions Also chemistry and mathematics of solutions, analysis of chemicals, sources, plant physiology, technique of nitrogen potassium balance, etc **$3 10**

4. SOILLESS GROWTH OF PLANTS—*By Carleton Ellis and Milton W Swaney* Complete information, popularly presented, regarding the problems and difficulties of tank farming Formulas for chemicals and instructions for preparing tanks and other containers are given Recommended to both experimenters and commercial growers **$2.85**

5. SCIENCE EXPERIENCES WITH HOME EQUIPMENT —*By C. J Lynde* A book of 200 simple home tricks based on physical laws, each experiment being illustrated and its principle explained **$1 45**

6. THE ENGINEER'S SKETCH-BOOK OF MECHANICAL MOVEMENTS—*By Thomas Walter Barber* Working drawings of practically every conceivable movement, device, appliance, and contrivance employed in the design and construction of machinery for every purpose Nearly 3000 illustrations **$4.35**

7. SUPERSONICS—*By Prof R. W. Wood* A great deal of data on science of inaudible sounds, their every aspect, physical and biological, by a noted physicist inventor Has bibliography of articles on subject in many journals **$2 10**

8. OH DOCTOR! MY FEET!—*By Dudley J Morton, M.D.* Help for foot sufferers Scientific treatment which makes possible discarding of arch supports and special shoes and stopping of exercises **$1 60**

9. HOW TO THINK STRAIGHT — *By Robert H Thouless* A book that will definitely clarify your thinking and show you the argumentative tricks of others **$2.10**

The above prices are postpaid in the United States Add, on foreign orders, 25c for postage on each book.

10. THE SCIENTIFIC AMERICAN CYCLOPEDIA OF FORMULAS—*By A. A. Hopkins* A standard reference volume of more than 15,000 formulas Indispensable in the laboratory, workshop, home **$5 50 in U S ; $6 00 elsewhere.**

11. PERSPECTIVE MADE EASY—*By Ernest R Norling* For draftsmen and artists, this volume tells the things they should know but often don't—all the details of perspective, simply explained and illustrated so that all rules may be easily grasped, progressively, from simple to complicated forms **$1 85**

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A Monthly Department for the Amateur Telescope Maker

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Of Springfield type mountings for reflecting telescopes, in contradistinction to the real McKay, which is the straight Springfield originated by R W Porter, described in the instruction book "Amateur Telescope Making" and revised by him in its sequel, "Amateur Telescope Making—Advanced," there are no end, each different and each ingenious The one in Figure 1 was made by Robert Phillips, 3448 Greenview Ave, Chicago, Ill He says the mounting was made from two Buick front wheel assemblies welded together at right angles with struts and cemented into a 5" pipe Setting circles are marked on the rims of the brake drums and, these being 36" in circumference, it was easy to mark off the divisions, ¼" equalling 2½° in dec and 10 minutes in R A The tube is made of ½" maple dowel stock on rings of plywood—too light according to standards, Phillips says, but he adds that he had no trouble with it Total cost of telescope was $25

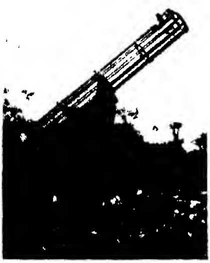


Figure 1: **Phillips mounting**

Another ingenious version of the Springfield type is that in Figure 2, an 8" with Micarta tube and an external framework of structural aluminum angle—a kind of exoskeleton Carl Oman, 433 Springdale Avenue, East Orange, N J, is the maker

When, once before, as above, we called something the real McKay, somebody wrote in to say that the correct expression was "the real McCoy," referring to the late boxing man, Kid McCoy That, however, is a corruption—one that, in fact, is not the real McKay—of the correct expression That expression had reference to a fancy whisky once made by McKay in Scotland, pronounced McEye Anyway, the virtual McCoy-McEye in Springfield mountings, except for its modified counter-weight support, is shown in **Figure 3.** You don't see many of them because it's a real job of work to make all the necessary patterns, castings, and machined parts Yet the end-product looks sweet enough to justify the pains if you have the equipment to do the making Charles F. Pope, 621 Courtland Ave, Park Ridge, Ill, sends in the photograph and says the telescope was made by Richard Traub of Park Ridge Figure 4 shows Pope's observatory dome, of 20-gage sheet steel over wooden frames

Flats are preferred by many, instead of prisms, as diagonals in reflecting telescopes In the following note Cyril G Wates, 7718 Jasper Ave, Edmonton, Alta, Canada, discusses the subject pointedly

"When the amateur has completed a really fine parabolic mirror, and has finished gloating over the beautiful optical 'doughnut' which the Foucault test reveals, he finds himself faced with the problem of diverting the reflected rays through the side of his telescope tube into the eyepiece Shall he use a right-angled prism, or shall he use an aluminized diagonal? I fail to find that sufficient emphasis has been laid upon the relative merits of prism and diagonal, either in these columns or in the pages of 'ATM' and 'ATMA' Perhaps there is a tendency among TNs to regard the two as optically equivalent, but this is far from being the case.

Figure 2: **Oman's mounting**

"Taking the diagonal first, it has one outstanding advantage Any diagonal mirror, no matter how much its surface may deviate from a plane, is absolutely achromatic Suitable diagonals with surfaces correct to one quarter wavelength are not too difficult to make, or may be purchased quite reasonably in the smaller sizes. This degree of accuracy is sufficient to insure realization of the fine qualities of a good objective, according to H H. Selby and others ('ATMA,' p. 131). In the days of silvered surfaces, amateurs were justified in fighting shy of diagonals, but modern methods of aluminizing remove all objections to these little mirrors Those who make their own diagonals may bear in mind, as I have pointed out in this department (September, 1938), that for long-focus mirrors the difference between a circular diagonal and a 'correct' ellipse, is purely academic The light cut off by the unused part of a circular diagonal is infinitesimal

"Turning to prisms, there is one bit of advice which should be burned into the brain of every aspiring amateur —*avoid inferior prisms as you would the plague* A diagonal mirror has only one place at which it can display defects, the surface The prism has six three angles and three surfaces While it is as easy (and as difficult) to figure the diagonal surface of a prism to the required standard, this perfection will be largely nullified if any of the angles are incorrect, or either of the other surfaces imperfect A right-angled prism with an accurate diagonal face, but with the other surfaces irregular and the angles incorrect, is exactly equivalent to a bit of cheap plate glass interposed between the eyepiece and the objective. Lack of parallelism between the faces of such a piece of glass would cause color fringes, and irregular surfaces would result in distortion and bad definition

"Even a perfect prism or a perfect 'plane-parallel' (the two are optically equivalent) causes color dispersion, an effect which, according to Pierce, is quite visible even with a focal ratio of *f/8* This dispersion, which

Figure 3: **Pope's Springfield**

appears as a faint fringe around such objects as the Moon and Venus, is unavoidable, but is so unobjectionable that the amateur need have no hesitancy in using a prism, provided it is a good one. Reputable dealers will, of course, supply just what is ordered, and it is unreasonable to expect a Grade A prism for the price of a discard. A fine prism is necessarily more expensive than an equally good diagonal, for the reasons already

Figure 4: **Pope and observatory**

stated. For short-focus mirrors, such as the RFT, it might be wise to decide upon a diagonal and avoid any possibility of color fringes, which are much more objectionable with a wide cone of rays

"What is the standard by which a prism should be judged? First, *all* surfaces should be correct to a quarter wavelength Second, the angles should be accurate within not more than 3 minutes of arc (Martin) The familiar 'split image' test ('ATM,' p 54) may be made extremely accurate, especially if a circular diaphragm or washer is used between the eye and the prism (Pierce), but this guarantees the correctness of the right-angle only, it is perfectly compatible with gross errors in the other angles. If you are in doubt, go to the physics department of the nearest university and get them to measure the angles for you

"A word with regard to collimation of a prism. The prism mounting must be adjustable in *all* directions Push-pull screws are hard to beat, combined, of course, with a rod sliding in the boss of the spider Eliason's method of reflection from the eyepiece face of the prism is excellent ('ATMA,' p 272), but does not go far enough The eyepiece face may be at right angles to the optical axis of the adapter tube, yet the mirror face (of the prism) may be hopelessly out of adjustment.

"It is advisable, therefore, to extend Eliason's adjustment by some such method as that shown in Figure 5, which has worked out well in practice. A disk of cardboard is attached to the mirror end of the tube In the exact center of the disk is a hole (at least ¼", to avoid diffraction), with two heavy black lines drawn diagonally through the hole, as shown.

The disk is illuminated by means of a flashlight, the end of the tube being covered by a black cloth.

"The prism is first adjusted to the eyepiece adapter by Eliason's method It is then further adjusted by watching the reflection of the diagonal lines and eyehole, in the mirror face of the prism When this adjustment is correct, the push-pull screws *must not be altered again*. If the prism no longer responds to Eliason's test, it

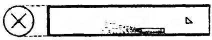


Figure 5. **Suggested by Wates**

must be corrected (1) by sliding the prism mounting in its collar, (2) by rotating the prism, (3) by altering the alinement of the eyepiece adapter If this method is pursued, both square faces of the prism will be exactly at right angles to the axes of both tubes

"If, after the prism is squared up as described, the mirror is not centered as seen through the adapter tube, the prism is probably bad, and Porter's method for warped mirrors should be tried ('ATM,' p 287)

"Finally, by all means use a prism if you can afford a really good one, but remember that bad collimation may cancel all the perfection for which you have parted with your hard-earned dollars. If funds are somewhat limited, use a diagonal, especially with short-focus mirrors For absolute freedom from color effects, the diagonal is certainly the choice, but even a hard aluminum film is delicate and subject to scratches A prism is free from this objection So there you are'"

Wates calls for prisms flat within a quarter wavelength and with angles within better than 3 minutes of arc from perfect ("pyramidal error 3'," the professional would term this) Just how good is this, compared with the prisms amateurs have been buying? Definite data are not available on the quality of all the prisms sold to amateurs in the past but here are some criteria The Perkin-Elmer Corporation, professionals, rate prisms as follows A-quality-precision, 1/8 wave or better and 5" pyr. error, or better A-quality, 1/8 to ¼ wave and 1' pyr. error or better. B-quality, ¼ to ½ wave and 5' or better. C-quality, 1 wave and 10' or better Thus, the prism Wates asks for is, after all, nothing especially superlative, falling in Class B and costing, for a prism with one-inch-square face, between $3 and $5. How many, if any, Class D, E, F, G . . X, Y, Z prisms have amateurs purchased in past years?

Your scribe recalls his first telescope, which had a prism picked up free because it was a reject You could have thrown a cat through the gap between its face and a try-square, yet the telescope provided a big thrill, at least for a little while, even if the prism did make of it almost a spectroscope At that time, 1926, the amateur telescope making hobby was a cub with burrs in its hair. Porter's statement, in "ATM," page 54, written also at about that time, that "the right angle of the prism need not be exactly 90° for our purpose," didn't seem and then wasn't much out of place. It is literally true today—within the tolerance quoted by Wates from Martin, but the language will be altered in future reprintings. Also by this test a prism could have a perfect right angle, yet the other angles might be, say, 44° and 46° respectively, without the tester being the wiser. Pierce claims that, with the prism held at 30", the split image test is good to 34 seconds of arc If made with a small telescope this accuracy would be correspondingly multiplied, he points out

Wates next continues with the description of a diagonal support of his design

"The 'classic' method of adjusting the diagonal by means of one or more slots in the tube is not only poor mechanical construction, but also has the serious objection that, when the screws are moved in the slots, the diagonal is swung away from the optical center of the tube My earlier design, which appeared in the October, 1935, number, is satisfactory for a prism, but is too bulky for an elliptical diagonal mirror The design shown in Figure 6 has been used in an RFT and can be adapted for any size telescope Because of the spherical surface between *A* and *B*, the diagonal moves as though pivoted on the optical center, thus greatly simplifying adjustment

"The diagonal is mounted in a brass tube, as described by Hindle in 'ATMA,' except that the space between the glass and the plate *A* is packed loosely with coarse steel wool. The top surface of *A* is turned to a

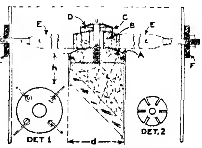
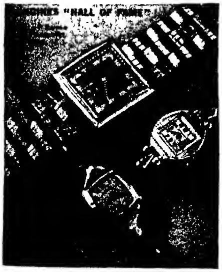


Figure 6: **Wates' support**

spherical surface with radius *r*, which could be measured with a caliper, but may be more accurately determined by the use of the equation

$$r = \sqrt{h^2 + hd + \frac{d^2}{2}}\,.$$

"The method of attaching the four vanes *E* to part *B* is shown in Detail 1. The slots in *B* are cut carefully with a fine hacksaw Note that the slots are slightly off-center. Half an inch of the ends of each vane is softened and tinned. One eighth inch is folded over, to fit into the holes in *B*, which



is then heated and the holes filled with solder. The tube of my RFT being sheet aluminum, the wrought iron ring *F* was used for stiffening.

"*D* is a spring steel washer, shown in Detail 2. The diagonal and its mounting can be moved in any direction without changing the position of its optical center and, when correct, the screw is driven home.

"In turning the three disks, *A*, *B*, and *C*, templates, both concave and convex, should be cut; one pair to radius *r* and the other to radius *r* plus the thickness of *B*. After turning to correct curve, the various surfaces may be ground together with fine Carborundum

"To forestall the criticism that there is no provision for longitudinal adjustment I will say that, although such adjustment can be provided, it is quite unnecessary If the spider ring is accurately mounted on the tube, the center of the diagonal will be in line with the center of the eyepiece tube If not, the ring can be moved until it is correct, and then permanently fixed"

In the May number of *The Journal of the British Astronomical Association*, F J Hargreaves describes his pet polishing lap—wax on pitch, as follows "The wax-on-pitch polisher consists of an under-layer of pitch supporting wax facets on a netting foundation The wax does not yield or flow under pressure, and therefore the grooves between the facets do not fill up in use, as with polishers of pitch only The pitch under-layer, however, can yield or flow to allow the wax facets to make contact uniformly with the surface being polished This under-layer can therefore be made as soft or as hard as desired, according to circumstances, leaving the wax-polishing layer unaffected" Grim are the circumstances under which this is reported in summer, from a meeting on the banks of the Thames

From S L Walkden, father of the RFT or Richest-Field Telescope, who lives in London, came, in the midst of the liveliest bombardment, a long letter about telescoptics and not a syllable about the war except to say that, London being permanently blacked out, he found with rejoicing that he could see fully three magnitudes of stars that previously were invisible, and with his own RFT he had found some thrilling Milky Way views

Your scribe lives in a New Jersey suburb on a corner surrounded by eight street lamps and bathed by three flood-lamps from a filling station, and the only time he ever even *sees* the Milky Way is when out of town

In case you are planning to use the King test ("ATMA," p. 269) and have intended to use the sugar and water solution suggested, don't; it won't work Other liquids—oils—have been substituted Write in and ask, if especially interested.

Patent, Trade Mark, and Related Legal Proceedings That May Have a Direct Effect on Your Business

By ORSON D. MUNN, Litt.B., L.L.B., Sc.D.
New York Bar
Editor, Scientific American

Preparedness

A RECENT amendment to the patent laws is intended to reënforce the preparedness program. The amendment grants to the Commissioner of Patents the right to withhold the publication and granting of a patent for such period or periods of time as in his opinion the national interest requires, where the publication of the invention would be detrimental to the public safety or defense. In this way inventions dealing with ordnance, bombs, or other military or naval weapons may be kept secret so as to prevent them from falling into the hands of foreign agents.

Heretofore many important inventions of this character were patented. Upon the issuance of the patents the inventions were published and were available for reference. The withholding of a patent might possibly work a hardship upon an inventor since he can only collect profits and damages for infringements occurring subsequent to the granting of the patent. In order to protect the inventor the amendment to the law also contains the provision that an applicant whose patent is withheld by the Commissioner shall tender his invention to the government and thereafter he shall have the right to sue for compensation in the Court of Claims, the compensation to begin from the date of use of the invention by the government. Thus it will be seen that the inventor can recover, from the government, compensation for the use of his invention occurring even prior to the granting of the patent.

Caruso

COMPETING manufacturers of food products were involved in a controversy over the right to register as a trade mark the name of the famous tenor, Enrico Caruso. The original user of the name Caruso had registered it in the United States Patent Office in 1918 as a trade mark for macaroni and similar food products. The other manufacturer registered the name as a trade mark for canned tomatoes and tomato paste in 1923. Subsequently the original user brought proceedings to cancel the later trade-mark registration of the other manufacturer.

It was argued by the second registrant that he had the right to maintain his registration because he had received permission from Mr. Caruso to use his name and picture in connection with his food products. The Patent Office and Court of Customs and Patent Appeals found that both registrants had received permission from Mr. Caruso to use his name and picture. It was held, however, that this *per se* was not controlling. The right to register a trade mark is controlled by the federal statutes relating to this subject and a person may not register a trade mark which is likely to cause confusion in trade. It was held that the registration of the name Caruso by the second registrant was likely to cause confusion with the trade mark of the first registrant and accordingly it was ordered to be cancelled.

Superman

A CARTOON strip relating to a fictitious character of superhuman strength identified as Wonderman was held to be an infringement of a copyright relating to a cartoon relating to a superhuman character identified as Superman. Each character was represented as being the strongest man in the world, as being the champion of the oppressed and as battling against evil and injustice. Each was represented as performing similar feats of superhuman strength such as crushing a gun in his hands and as catching the bullets or shells from a gun and throwing them back to the place whence they emanated. It was contended by the infringer that the copyright was invalid because the cartoon character Superman was merely a comic Hercules. This argument was rejected by the Court for the reason that an original production or creation, however poor in quality, is entitled to copyright protection.

In this connection, the Court stated: "But if the author of 'Superman' has portrayed a comic Hercules, yet if his production involves more than the presentation of a general type, he may copyright it and say of it: 'A poor thing but mine own'."

Ascap

A NEBRASKA statute which would have destroyed or seriously handicapped an organization through which a large number of authors, composers, and publishers of musical compositions receive substantial income for the production of their compositions was recently declared unconstitutional by a Federal Court. This statute declared it to be unlawful for authors, composers, and publishers to form any society, association, or

similar combination wherein the members constituted a substantial portion of the authors, composers, and publishers within the United States and when at least one of the objects of the combination was the determination and fixation of license fees

The statute provided further that thereafter all license fees fixed by such a combination were null and void and that authors, composers, and publishers should specify on printed copies of their musical composition the license fees charged for private and public renditions of the composition Upon payment of the specified fee the purchaser of the composition could use or render the composition without any further obligation

The statute also provided that if the author, composer, or publisher failed to specify a license fee on printed copies of the composition then any purchaser thereof was free to use and render it without the payment of any license fee whatsoever

The American Society of Composers, Authors, and Publishers, an association of approximately one thousand composers and of 123 publishers, commonly known as Ascap, brought suit against the Secretary of State of Nebraska to enjoin the enforcement of the statute on the grounds that the statute was unconstitutional. The Court held that the provision of the statute requiring the owner of a copyrighted musical composition to offer it for sale in a certain manner, i e, by specifying a license fee on printed copies of the composition and the provision depriving him of any compensation if he fails to offer the composition for sale in the manner specified was in violation of the Federal Constitution and also of the Federal Copyright Act in that it denied the copyright proprietor due process of law

Bacteria

The lowly bacteria which has been accused of causing many of the human woes and illnesses has now been deprived of the benefits of our patent law

The patent law provides in part that anyone who has invented or discovered any new variety of plant which can be asexually reproduced is entitled to receive a patent. Under this section of the law an attempt was made to obtain a patent on a new form of bacteria The Patent Office rejected the application for the patent on the grounds that a bacteria was not a plant within the meaning of the patent law

An appeal was taken to the Court of Customs and Patent Appeals and the court ruled that while scientifically a bacteria was a plant, Congress intended that the word "plant" should be given its popular meaning and this did not include bacteria The Court accordingly sustained the Patent Office in refusing to grant a patent for bacteria.

(The Editor will appreciate it if you will mention Scientific American when writing for any of the publications listed below)

PLASTICO ROK SERVICE BULLETIN is a pamphlet showing a wide variety of uses for the mending and patching plastic material which was described on page 222 of the April 1940 issue of Scientific American. *Technical Supply Co, Palo Alto, California—Gratis*

THE DENSITOMETER AND ITS USE IN COLOR PRINTING is a manual published for use with the Marshall Densitometer However, it offers valuable information to all interested in making color prints. Text and illustrations are non-technical The manual covers, in comprehensive form, such important points as. instructions outlining the general requirements of good color prints, how to make accurately balanced separation negatives, how to use gray scales, general use of densitometers in color work, how to check separation negatives, etc Included are time-gamma charts, filter factors, etc Gratis to purchasers of Marshall Densitometer; 25 cents to others *Albert Specialty Co, 231 South Green St., Chicago, Illinois*

RESEARCH LOOKS TO NEW HORIZONS is a 32-page booklet, illustrated in colors, showing the progress of research and industry from early horizons to the present day Specific examples show the startling results that have been obtained by research intelligently applied *Department of Public Relations, General Motors Corporation, Detroit, Michigan.—Gratis*

TENITE is a 28-page booklet that describes this plastic material and illustrates many of its uses in a wide range of industries The book is of particular interest to manufacturers, molders and designers. Please request it on your business letterhead. *Tennessee Eastman Corporation, Kingsport, Tennessee—Gratis.*

DU PONT'S PARTNERSHIP WITH THE FARMER is a booklet which shows clearly that both products for the farm and those made from farm products have been made available through chemical research The booklet also shows how many farm products, after processing, go back to the farm either for direct use or as aids in the preservation and marketing of other farm products *Agricultural News Letter, E I. Du Pont de Nemours & Co., Inc, Wilmington, Delaware—Gratis*

THE WORKING OF S. A E NICKEL ALLOY STEELS is a 16-page pamphlet of data compiled from the practice of 34 leading fabricators. It covers effects of heat treatment, and gives practical instructions for machining, grinding, welding, and gas cutting. *The International Nickel Company, Inc., 67 Wall Street, New York, N. Y.—Gratis.*

"HAM GUIDE" was written specifically to tell the radio amateur how to use RCA transmitting tubes to best advantage. It also includes constructional articles, giving complete details for building two medium-power amateur transmitters More than 70 illustrations and over 30 transmitting circuits are presented *Commercial Engineering Section, RCA Manufacturing Company, Harrison, N. J.—15 cents.*

A NATIONAL TRANSPORTATION POLICY, by Senator Clyde M Reed, is a 14-page booklet that outlines the problems of transportation in the United States and presents facts aimed toward their solution *Association of American Railroads, Transportation Bldg, Washington, D C.—Gratis.*

ALPHA SYSTEM OF BRIDGE DESIGN is a 26-page illustrated booklet that describes a system of steel and reinforced concrete construction relating particularly to bridges. It is claimed that this system combines the rigidity of reinforced concrete with much lower cost and gives the accuracy, simplicity, and rapidity of steel construction *Porete Mfg Co, North Arlington, New Jersey—Gratis.*

PLATING AND FINISHING GUIDEBOOK comprises 136 pages of practical information in the plating and finishing industries, plus 70 pages of advertising and "quick-mailing coupon service" for readers. The text consists of a series of articles covering all phases of plating and finishing. *The Metal Industry Publishing Co., Inc, 116 John St., New York City—25 cents*

G-E HOME WIRING HANDBOOK is a 24-page pamphlet that is essentially a guide for planning electrical wiring for homes It outlines wiring requirements and specifications, shows how to determine the adequacy of wiring, and gives a chart of residential outlet requirements *General Electric Company, Bridgeport, Connecticut.—Gratis.*

CUT STEEL PROFITABLY WITH KENNAMETAL TOOLS AND BLANKS is a 6-page folder describing this tool alloy. It includes tables of comparative physical properties and recommended speeds for machining steels of various hardnesses. Illustrations show typical turning, milling, and shaping operations. Bulletin 740. *McKenna Metals Co., 341 Lloyd Ave., Latrobe, Pa.—Gratis if requested on business letterhead.*

C. P. CHEMICALS AND ACIDS is a 158-page catalog of "Baker's Analyzed" laboratory and technical chemicals. *J. T. Baker Chemical Company, Phillipsburg, New Jersey.—Gratis.*

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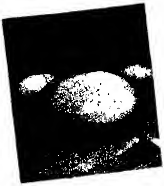

HORTONSPHEROIDS in a modern refinery in the West Indies are the interesting objects shown on our front cover These have a capacity of 20,000 barrels each and are used to store gasoline under two and one half pounds pressure to reduce excessive evaporation losses

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SCIENTIFIC AMERICAN

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NINETY-SIXTH YEAR • ORSON D. MUNN, Editor

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NOVEMBER • 1940

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SCIENTIA OMNIA VINCIT

NYLON, it was said in these pages last month, probably will not cut deeply into the Japanese silk industry for five to ten years. When and if it does, that will be the Japanese farmer's worry, what disturbs some cotton men is the expanding use of rayon Indeed, to that fiber is attributed a sizeable part of the problem now facing American cotton farmers

Rayon production has increased nearly a thousand percent since 1924, says the *Industrial Bulletin* of Arthur D. Little, Inc. Yet, reports that circular, it was not until 1938 that rayon consumption exceeded that of scoured wool and became a poor second to that of cotton And if rayon consumption doubles in the next decade, it will still total a third of current cotton consumption

Growers of the natural fiber, nevertheless, may not rest content That one third is the equivalent of several million bales of cotton Already an increasing production of cotton abroad is cutting into our exports, may cut far more heavily as the years pass And with rayon taking a larger share of the home market's cash, it seems appropriate that the American cotton farmer take stock of the situation and readjust his economy in time to meet and weather the storm Assuredly, rayon is going to be used more widely in rugs, tires, many fabrics that now commonly use cotton, and, in "staple fiber" form, as a mixer with cotton fibers in cloths traditionally made of cotton

There is one bright light on this dark horizon Down in North Carolina, there have been under way for years experiments in turning the whole cotton plant—stalk, leaves, boll, and fiber—into rayon The plants are mowed down, oil is extracted from the seeds in this bunch of sticks and fiber by use of solvents, and the remaining cellulosic material is made into rayon Years ago, this process was a laboratory success If and when it is made commercially practicable, it will save our trees—which now go into rayon—will take up surplus cotton stocks, and will sidestep that part of cotton production which is more costly than all others combined the picking job

For decades, the cotton grower has been roundly scolded for concentrating stubbornly on his one crop Still, he sticks to it. Perhaps he cannot interpret the handwriting on the wall, "Science conquers all," as saying that science replaces the old with the new. If he doesn't now make a determined effort to understand, he may soon be complaining of technological displacement —*F D. M*

DEFEND YOURSELF OR DISARM

THE right of the American citizen to bear arms, secured by the Constitution of the United States, has definitely been abridged by local and state laws, but has never—*yet*—been completely rescinded That "yet" is important If certain fanatical anti-firearms groups were permitted to have their way, every sporting arm in this country might have to be registered and its owner duly "mugged" and fingerprinted. Or, even worse, such firearms might be subject to confiscation or to storage in some public place when not in actual use.

Every sportsman who uses firearms—whether he

"plinks" with a .22, is a devotee of skeet or trap, or likes to punch holes in paper targets with rifle or pistol—should be aware of the dangers that threaten his sport Anti-firearms fanatics formerly used the crime-prevention pretext for proposed legislation. Now they have a new one National defense! They would keep weapons out of the hands of fifth columnists by taking them away from everyone! And just as does the thug and crook, the fifth columnist will hide his firearms where they are readily available, while the law-abiding citizen complies with the rules and leaves himself unarmed! The theory is beautiful, but it does not work out in practice

In this same vein, Eltinge F Warner, well-known sportsman and publisher of *Field and Stream*, holds up Switzerland as an example of a free nation where anti-firearm agitators would never be happy. "For many months," says Mr. Warner, "little Switzerland has been surrounded on all sides by warring nations, but up to today she has not felt the tramp of hostile armies When a war plane crosses the Swiss border, the Swiss open fire. She is small, but she is mighty. Rumors have been current that armies would march across Swiss soil, yet up to date Switzerland is the only country in the theater of war that has not been ridden over roughshod

"The citizens of that courageous republic," continues Mr Warner, "don't keep their guns in public armories At all times the citizen of Switzerland has a military rifle within reach, and he knows how to use it Every young man is an army graduate When he has completed his military training, he takes his government rifle or hand-gun home with him And each year thereafter he is allotted a certain amount of ammunition and required to shoot this ammunition in order that he may keep familiar with firearms and know what a good rifle and a good pistol or revolver can do Even the most rabid anti-firearm crank must admit that Switzerland would be an unhealthy place for hostile parachute troops to land "

We cannot help recalling that this vast nation of ours was virtually built by men whose very lives and livelihoods depended on their skill with firearms True, the march of civilization has changed this picture materially, but it can never change the love that millions of American men hold for firearms and their use It rests in the hands of these same men—you and I—to preserve for all of us the right to own and use rifles, hand guns, and shot-guns in the pursuit of sport and recreation. Make use of our democratic processes by letting your legislators know *now* that you, together with millions of others, want no interference with your rights in this matter. Write Telegraph. Make yourself heard in the halls of Congress

National defense by disarming the citizens! By the Red Gods, what a travesty!—*O D M*

50 Years Ago in . . .

Scientific American

(Condensed From Issues of November, 1890)

CANAL—Recent cable advices report that work is being energetically pushed on the Nicaragua Canal . . An aqueduct twelve miles long, to bring pure water from the mountain streams, is being laid Offices, hospitals, and quarters for employes of the company, adequate to the present needs, have been erected Several millions of feet of lumber have been received from Atlantic and Gulf ports, and cargoes are continually arriving

LIGHT COST—Incandescent electric lamps are lessening in cost of manufacture while, at the same time, increasing in efficiency, that is to say in length of life Now, with improvements in exhausting apparatus, it costs but a tithe of the old figure to produce a more perfect vacuum, the sealing of the platinum wires is done by machinery, and as a result a far more certain and a longer-lived lamp than that which once cost $1 may be had for considerably less than the half of it

WAR TRENDS—The conditions under which the next armed conflict between powerful countries must take place are of an altogether different character from those known heretofore; but in such future contest, come when it may, it is safe to say that science and skill, rather than brute force, will have a determining influence to an extent never before known in the annals of war

HORSE MEAT—Just twenty-four years ago the first horse butcher in Paris opened his shop. Since then there have been started nearly 140 horse flesh shops in the department of the Seine, and at the present time about 20,000 horses are killed every year in Paris for human food In Paris the price of the meat is less than half that of ordinary butcher's meat Berlin is following the example of Paris

LUMBER—In 1880 the 25,708 saw mills then in operation converted $120,000,000 worth of raw timber stock into various kinds of lumber, at the same rate there would be no good-sized timber left in forty years

EFFICIENCY—Another path in which the American iron works can now develop is in that of reducing wastes of fuel and of material Now that mechanical engineering has developed machinery for handling to such an extent that the smallest possible amount of manual labor is required, the engineers might be allowed to take a rest in this direction and devote themselves to perfecting the steam boilers and engines and furnaces, with a view to saving fuel

COLUMBUS—In the confusion of new and old times, and of different years . it is far from easy to determine the exact anniversary of Columbus' first sight of our shores Four hundred years ago many discrepancies existed in the times of celebration of Christmas, and there is even a possibility that the year should be 1491 or 1493

STREET LIGHTS—One of the companies in Paris that deal in compressed air for motive power has been awarded the contract for street lighting on a novel plan The company distributes power through its condensed air system to an immense number of small dynamos, each of which furnishes current for a small number of lamps

TORNADOES—A special investigation of the subject of tornadoes has been carried on by Prof H. A. Hazen, of the Government Signal Service, during the past year It appears that in no State may a destructive tornado be expected oftener, on an average, than once in two years, and that the area over which the total destruction can be expected is exceedingly small

UNDERGROUND—Among the new works lately inaugurated in London is an underground electric railway known as the City and South London Railway, 3¼ miles in length The road-bed consists of two tracks 4 feet 8½ inches in width, which are laid in two underground tunnels, each 10½ feet diameter There are four stations

One of the peculiarities of the work is its great depth underground, the rails being, with few exceptions, not less than 40 feet below the streets, while in some places they are 100 feet underground. At the stations the two tunnels are brought into an enlarged chamber built underground, and from these passengers are raised by elevators to the street level The cars are propelled by electric locomotives, of which fourteen have been supplied The locomotives are able to make a speed of 25 miles an hour, but the trip of 3¼ miles, making four stops, is made at the rate of 15 miles an hour

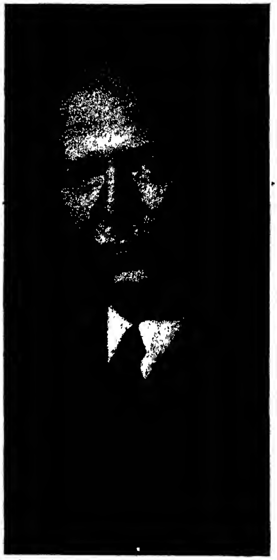
GROWTH—In Denmark and Sweden it has been the custom for many years to weigh and measure the school children every year. Out of 15,000 boys and 3,000 girls the results were as follows In the seventh or eighth year of life boys grow considerably in height and in weight, after which a delay sets in which reaches its maximum in the tenth year and lasts till the fourteenth year, when a considerable acceleration of growth suddenly sets in.

INSULATION—There is great need of improvements in insulating material An insulation for wires is needed that will be cheap, light, flexible, and durable; one that dampness will not decay, nor the heat of an electric arc dissolve or burn

PAPER PIPES—Gas pipes from paper are made from strips of manila paper equal in width to the length of the pipe to be made, which is passed through a vessel with melted asphalt, and then wrapped firmly and uniformly around an iron core until the required thickness is attained. The pipe is then subjected to powerful pressure. . . These pipes are claimed to be perfectly gas tight . . . and very resisting to shocks and concussions.

OUR PART IN NATIONAL DEFENSE

THE BELL SYSTEM IS A NATION-WIDE TELEPHONE SYSTEM — READY TO SERVE THE UNITED STATES IN NORMAL TIMES OR EMERGENCY. IT HAS . .



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Walter S. Gifford

THE BELL SYSTEM IS READY TO DO ITS PART IN THE NATION'S PROGRAM OF NATIONAL DEFENSE

THROUGH THE SCIENCE LITERATURE OF THE WORLD

TO CORRECT WIDESPREAD MISCONCEPTIONS—During a five-year test, F. H. Frankland, Chief Engineer of the American Institute of Steel Construction, observed that in a wind of 80 miles per hour the Empire State Building in the City of New York took a temporary lean of about 2¾ inches, and then swayed across that lean at the rate of 7.85 times per minute through an eight-inch arc. Thus, at one end of each sway the building reached 6¾ inches out of plumb away from the wind, and at the other end returned to 1¼ inch beyond plumb toward the wind

REFRIGERATOR MILEAGE—The compressor motor of an electric refrigerator travels the equivalent of 250,000 miles in five years' normal operation—enough to carry it around the world 10 times if it could travel under its own power.—Notes, Westinghouse Electric & Manufacturing Company.

A TRAIN EVERY FIVE SECONDS—Approximately 18,000 passenger trains and about 15,200 freight trains operate daily over the tracks of the American railroads On this basis, a passenger train starts on its run somewhere in the United States every 4 8 seconds, and a freight train starts on its run every 5 7 seconds, day and night, on the average.—Association of American Railroads

MOTH LARVAE CRAWL IN—Experiments prove that a flying moth will lay her eggs in the crack of a chest or closet and the larvae when hatched will have no trouble crawling into the container if the opening is about the thickness of newsprint paper. Sealing with gummed tape is recommended —Wallace Colman, United States Bureau of Entomology and Plant Quarantine.

CHEESE MINES—Much Roquefort type cheese, which requires to ripen an atmosphere nearly saturated with water and varying but slightly from 48 degrees, Fahrenheit, is being made in quantities in this country—in caves along the Mississippi near St Paul, in rooms into which icy water trickles constantly, turning a fan for gentle air circulation, in abandoned coal mines, and in numerous small caves —*The Industrial Bulletin* of Arthur D. Little, Inc.—No. 159.

MOTES—Research engineers have measured more than 100,000,000 dirt particles in a single cubic foot of air in one particularly dirty city —Notes, Westinghouse Electric & Manufacturing Company

WAR EXPORTS—For war supplies, Japan has depended primarily on seven countries headed by the United States. In percentages, imports of such supplies from these countries were as follows United States, 55.7, British Malaya, 8.7; Canada, 8.5, Netherlands Indies, 8 3, Germany, 4.3; British India, 3 3; Italy, 1 3 —Dr T. Y Hu, Chinese Council for Economic Research

COLONIC IRRIGATION—It is extremely difficult to determine the field of usefulness, if any, of colonic irrigation While the role of the small cleansing enema and of the medicated retention enema seems well established, colonic lavage has been outrageously exploited in many quarters There is little evidence to show that it may benefit diseases of the colon and there is none for the stomach. On the other hand, it may cause harm.—*The Journal of the American Medical Association*, August 3, 1940, page 404

COLDER ICE—Ice men in Bangor, Maine, have found that their crystal-clear natural ice, frozen at —20 degrees, Fahrenheit, lasts longer than artificial ice frozen at 15 degrees. The ice is used extensively in air-conditioning Pullman cars between Bangor and Boston —*Taylor Rochester*, Summer Edition, 1940

YARN—Some cotton yarn is so fine that 50 miles of it are needed to make one pound This yarn is spun on ordinary textile machinery to make typewriter ribbons, airplane fabrics, and fine dress goods —R J. Cheatham, U. S. Department of Agriculture.

ROSE INDUSTRY—More than one half of the world's supply of rose-bushes, or 20,000,000 per year, are now grown commercially in Texas They are of 16,000 varieties. The industry, mainly in eastern Texas, ships rose bushes to every state and to 25 foreign countries.—Notes, American Petroleum Institute.

COMMON PIMPLES—Among Eskimos, native black Africans, Australian aborigines, and Maoris, acne vulgaris appears to be a much less common disorder than it is among civilized white people. As the Maoris adopt modern methods of living, the condition occurs more frequently.—*The Journal of the American Medical Association*, August 17, 1940, p 555

AIR CONDITIONING—Schools of air conditioning and refrigeration attract students with glowing promises of work in an uncrowded field, fail to give proper training, and much bitter disappointment is the result.—*Refrigerating Engineering.*

SCIENCE FRUSTRATED, PERVERTED—The function of science is to unite the whole human family, whereas the function of politics seems to be, both in the case of the human family and of each nation, to create parties and to emphasize them as much as possible.—*Nature*, August 3, 1940

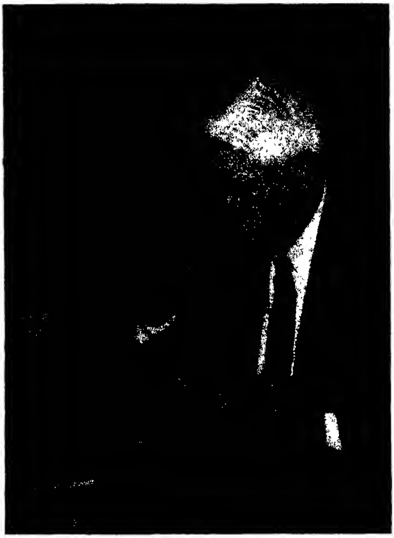
MILK WINE—Either sherry or sauterne type wine can be made from milk whey. So far, however, only seven bottles of milk wine have been made. It has an alcoholic content of 15 percent by volume.—Notes, National Dairy Products Corporation.

EFFECT OF SCIENCE—The chances of a new-born child reaching age 65 are today as great as the chances of reaching 50 were only 30 years ago.—Dr. Louis I Dublin, Metropolitan Life Insurance Company.

TOOL ALLOY—Important to our national defense program, the steel-cutting tool material, Carboloy, was produced in July in a quantity four times that of July 1939. Also exceeded was the previous peak month of June 1940 —Notes, Carboloy Company, Inc.

WIDOWS—Every year about 400,000 wives in the United States become widows. The average age of widows at the death of their husbands is somewhat less than 55 years, and practically one quarter of them—that is, about 100,000—are at ages under 45 —*Statistical Bulletin*, Metropolitan Life Insurance Company, August, 1940.

Personalities in Industry



WILLIAM H. MASON

WHEN William H. Mason was six years old he admired a new two-wheeled "break-cart" on his father's horse farm in West Virginia Here, he saw, was a vehicle getting along with half as many wheels as usual. Why, this youngster thought, couldn't you go one step farther and have a one-wheeled cart? He labored and whittled and finally produced a one-wheeled cart, but it turned out to be only a wheelbarrow. He was disappointed, but he had taken his first step in a career of invention.

Mason is not the wild-eyed, long-haired type of genius Now, as vice-president in charge of research of Masonite Corporation—a huge concern that sprang from his own research—he is intensely human and exceedingly modest Rather than talk about himself, Mason, if you will let him, will invariably swing the conversation around to one of his pet subjects, the late Thomas Alva Edison, with whom he was associated for 17 years.

Much of Mason's youth was spent breaking and training trotting and gaited horses. After several years at Washington & Lee, he transferred to Cornell to study mechanical engineering When the Spanish-American war broke out he left college to become a naval engineer.

After a shoe factory job, Mason went to work as a draftsman in planning Edison's new cement plant at New Village, New Jersey. Mason was retained by Edison to help supervise actual construction of the plant, and later became building superintendent of all of Edison's various enterprises.

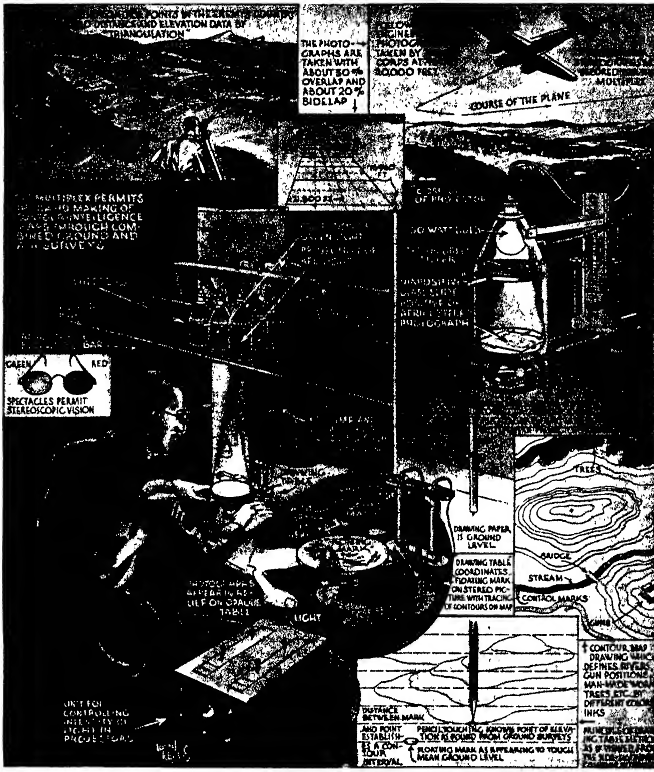
In 1916 Mr. Mason again pulled up stakes to serve his country. He was given charge of all construction for the U. S. Merchant Shipbuilding Corp., at Bristol, New Jersey. Later he went South to go into the business of extracting naval stores from sawn lumber, in which he employed a process of his own. He made his headquarters at Laurel, Mississippi.

Mr Mason watched with interest and concern the large proportion of a tree that was utter waste in the saw mills—edgings, slabs, boards of unmarketable shape or size. Here, he thought, was a vast supply of valuable raw material going to waste. If some economical means of reducing those scraps to fiber could be found, it would be a blessing to the paper industry

Mr Mason found a way. He bored a deep hole in the end of a piece of steel shaft to form a cylinder. In the hole he placed clean wood chips and a little water, and then plugged up the end. He heated the cylinder with blow torches until about 600 pounds of steam pressure was generated inside Then he suddenly released the plug There was a roar, and the air was filled with a shower of wood fiber

The fiber was too tough and strong to make a good grade of paper. Besides, the lignin—nature's binding cement—that coated the fiber would make the paper harsh. Instead of trying to eliminate the lignin, Mr. Mason turned it to advantage. Under heat and pressure he made the damp fiber mass into dense, smooth boards that could be used in hundreds of ways that its parent material, wood, could not, and that could withstand punishment which would destroy wood. The lignin, instead of being a drawback, served to hold the fibers together Mason had, using nature's own materials, improved on nature. His "Presdwood" had no grain, it would not splinter, would not warp, and it had a high resistance to moisture A new industry was born. Mississippi farmers had a new crop. Before long they were cultivating second-growth pine, heretofore of little value

While the above article on the activities of Mr. Mason was being prepared for printing, word was received of his sudden and untimely death.—*The Editor*.



RELIEF MAPS FROM AERIAL PHOTOGRAPHS

BEFORE guns can be trained on an enemy, that enemy must be put on a spot and that spot must be on a map—a map that shows elevations as well as linear distances Accordingly, U S Army engineers are employing a method of producing relief or topographic maps from stereo photographs made by the Air Corps Essentials of the system employed are shown above. Although it is impossible to survey enemy territory from the ground, preliminary control points may be established by the usual methods. Then stereo photographs are taken from the air and, reduced to proper size, projected in the Multiplex instrument shown. Now, by means of accurate controls, the operator adjusts the floating mark so that it appears to rest on a certain level of the stereoscopic image Then, by guiding the instrument over the drawing table so that the floating mark appears to follow points of the same altitude, the pencil attached will trace a contour line. The floating mark is then adjusted to another level, in predetermined scale, and the process repeated. The finished drawing will form a topographic map.

96TH YEAR SCIENTIFIC AMERICAN NOVEMBER 1940

RUBBER FOR AMERICA

Chemical Factories at Home, Plantations in Brazil

WILLIAM B. LANDIS

As the unsettled course of world events focuses nation-wide attention on the problems of national preparedness, the question of obtaining adequate supplies of commodities and materials essential to American national defense is under frequent discussion

One of the most important of these materials is rubber, about 90 percent of which comes from British and Dutch possessions in the East Indies. The possibility that this rubber supply will be cut off, or at least curtailed in future years, looms as a serious threat, particularly if the rubber colonies should be seized by one of the totalitarian powers. In many circles it is believed that such a situation would have serious consequences, particularly in regard to its effect upon our national defense program.

However, the picture appears less dark for the immediate future when studied in the light of other facts Stocks of crude rubber on hand and afloat are sufficient to meet the nation's normal requirements for nearly six months, and efforts are being made to increase this supply still further For example, crude rubber now in transit to United States ports is approximately double the amount in transit a year ago. But in spite of these accelerated shipments, it is now too late to obtain reserve supplies of crude rubber sufficient to meet our needs, if the supply from the East Indies should suddenly be cut off.

A study of the situation reveals two possible solutions to the problem. The first is rapid development of artificial or synthetic rubber. The second is to establish supply sources closer to home.

Of these two courses, mass production of "synthetic rubber" has the greatest immediate possibilities While real tonnage production of synthetic rubber is lacking at present, and prices are consequently somewhat higher than for natural rubber, producers of the chemical product are of the opinion

that they can swing into large scale production within six to eight months, should the necessity arise

Although no definite predictions can be made regarding price, it is thought that chemical rubber can eventually be produced at a cost that will bring it within the price range of natural rubber This opinion is based on the low cost of raw material from which chemical rubber is made, together with the fact that mass production methods might reasonably be expected to lower the now expensive processing costs

Already factory-made rubber is serving a variety of useful purposes, especially in the automobile and aviation industries. In many cases it is not only proving a most desirable substitute for the natural product, particularly in places where resistance to oil and heat is required, but it is also replacing leather and other materials to a large extent

In tensile strength, vibration resistance, and other physical properties, most chemical rubbers compare favorably with the natural product. Most varieties can be worked on existing equipment in American rubber factories and can be vulcanized or processed at the same speed as natural rubber

To conserve the nation's supply of natural rubber, consumption of that product can be reduced by approximately one half, a prominent manufacturer declared recently, if the natural rubber in tire treads and sidewalls alone is replaced with a recently developed chemical rubber Research in that direction undoubtedly will bring out still further means of conserving the nation's natural rubber supply, either by outright substitution of factory rubber for the natural, or by combining the natural and artificial products

Obviously, any extensive use or large scale production of chemical rubber in this country within the next few months would necessarily have to be accomplished under pressure, as an emergency measure Many authorities agree that, from a long-range standpoint, the development of chemical rubber should go hand in hand with establishment of a source of natural rubber in the Western Hemisphere Thus the threat that rubber shipments from the East Indies may be cut off has at least served to make America realize that something must be done quickly, if no pinch is to result from the possible curtailment of the main source of supply.

That something was already being done long before foreign events took their present disastrous course is evident from the advancements made in developing chemical rubbers

Progress has also been made toward establishing a source of crude rubber supply in the Western Hemisphere, particularly in Brazil The Ford Motor Company has a $20,000,000 project, consisting of two plantations, under way there on land along the Tapajoz River, a major tributary of the Amazon.

This program, launched on a

In rubber-tree bud-grafting, a bud from a "clone," or family, with desirable characteristics, is grafted near the base of a healthy seedling. The graft is wrapped with waxed tape, acres of bud-grafts presenting the sight seen directly below. At bottom of page are the healthy plants long after the seedlings were cut away. Trunks near ground show the offset or angle of the original bud-graft

more or less tentative basis in 1928, and expanded to its present proportions in 1934, is scheduled for completion in 1950. It is expected to produce an average of 1000 pounds of rubber to the acre, or 76,000,000 pounds annually. Whether or not the project can be completed by the scheduled time depends upon a number of factors, chief of which is the problem of obtaining sufficient native help. In some circles it is believed that the necessary labor might be obtained through the co-operation of the Brazilian government, particularly since a number of Brazilian leaders are urging that country to do everything possible to regain at least a measure of the supremacy it once enjoyed as a rubber producer.

In that connection, it is interesting to note that the Ford rubber estates, operated under concessions from the State of Para, are located close to the spot from which Henry Wyckham, an English adventurer, smuggled 70,000 seeds of rubber trees of all varieties, 78 years ago. Planted in the famous Kew Gardens at London, these seeds produced 19,000 healthy seedlings which were taken to the East Indies and used in founding the great rubber plantations there. For his part in this, Wyckham was knighted.

Descendants of these very trees now have been brought back to Brazil to strengthen the native stocks and develop high yielding varieties. These East Indian plantation varieties, which are expected to rehabilitate the jungle varieties and make them suitable for plantation growing, are the very finest

that have been developed in the Far East. They represent the fruits of an intensive program of propagation and cross-pollination which British and Dutch interests have carried on for years, to develop rubber trees with high yield and other desirable characteristics.

As a result of this research, rubber trees have been developed in the East Indies with yields running as high as 2400 pounds to the acre. Incidentally, in the rubber industry an "acre" means 100 trees, without regard to the area concerned.

When one compares the high yield of the East Indian trees with the 300-pounds-per-acre average yield of jungle rubber, one wonders why such a difference exists, especially when present-day East Indian varieties and native Brazilian trees are descended from the same stock. Botanists attribute this to selective propagation, a process similar to stock breeding methods by means of which thoroughbred horses and cattle are produced.

At the Brazilian rubber plantations, it is expected to increase the yield of the native jungle trees by crossing with East Indian trees and also by scientific planting and cultivation. For the present, the estimated yield is set at 1000 pounds per acre, although subsequent developments may change that figure.

Although many problems have been encountered in developing the estates, operations are well under way at Belterra and Fordlandia—the company's two plantations located 24 and 110 miles respectively up the Tapajoz from its confluence with the Amazon. Concessions upon which these plantations are located embrace a total area of more than 2,000,000 acres.

At Belterra, where it is expected that rubber will be produced commercially in rather substantial quantities by 1941 or 1942, more than 12,000 acres have been cleared and planted with approximately 2,675,000 rubber trees. These are almost entirely bud-grafted with high yielding clones from Sumatra, Java, and Ceylon. In rubber terminology it should be explained, a "clone" is a rubber "family" of definite, known characteristics which have been propa-

gated by the process of crossing.

At the Fordlandia plantation, where 6500 acres have been cleared, activities are given almost entirely to experimental work and research. Here the Ford Motor Company has planted one million trees and is conducting all kinds of experiments to produce a high-yielding Brazilian clone that will be immune to South American leaf disease and will possess other desirable qualities

Test tappings are being taken primarily to determine what characteristics the trees are developing, but rubber thus obtained is being shipped in latex form to the Ford plant in Dearborn, where it is used in making tire fabric In addition to developing various creaming agents to facilitate shipment of latex with a high dry rubber content, the company is also experimenting with smoked sheets, in which form a large part of the world's crude rubber is shipped

IT might be mentioned in passing that many experts regard Brazilian rubber as the finest in the world Although the native Brazilian trees have a lower yield than their cousins from the Far East, the rubber they produce is unsurpassed in quality and is used largely in the manufacture of surgical supplies

To combine the high quality of the native Brazilian trees with the high yield and good health of the East Indian varieties is perhaps the main purpose of the research now being done on the Ford plantations

Crossing these varieties is accomplished in two ways: by cross-pollination and by bud-grafting Cross-pollination produces a seed that will reproduce the dominant characteristics of the two parent trees Bud-grafting, on the other hand, may be used to speed the processes of multiplication and also to give one tree the desirable characteristics of several others.

Inasmuch as cross-pollination and bud-grafting play a prominent role in rubber tree propagation, a brief outline of the natural process involved might not be amiss. Before they are "crossed" by insects, two trees must be in bloom at the same time All male blossoms are stripped from one tree, and all female blossoms from the other Bees are then placed in a cheese cloth sack, over the male flowers (from which they gather pollen) and are later transferred to the trees from which the male flowers have been removed. Crossing by artificial means is successful approximately 7 to 9 percent of the time, while when bees are used as outlined, 20 to 25 percent successful results are obtained After pollination, the blossoms develop into seed pods, each seed containing certain definite characteristics of the two parent trees.

In tapping a rubber tree, a special knife is used to make a cut, two feet from the ground, on a 30-degree angle along half the circumference. Care is taken not to cut into the cambium layer. A spout at the lower end of cut directs into a small cup the latex which flows from the bark

Bud-grafting is done about a year after seeds are planted Bud-patches are cut in the seedling trees three to four inches above the ground, and a bud cut from bud-wood of high yielding clones is inserted in the bud-patch of the seedling. The patch is then turned to its original position, enclosing the bud, and taped in place with a waxed bandage.

Twenty-one days after budding, the bandage is removed in order to see whether the bud is alive If it is, the bark that covered the bud and which still adheres to the lower part, is cut off Seven days later the budded rubber trees are again inspected If the buds have continued well, the rubber trees that were used as stock are cut off one and one-half inches above the bud, at an angle of 45 degrees so that rain water will not accumulate After this, the budded rubber trees are inspected monthly Shoots that naturally appear in the cut-back trees are pruned Trees that die are replaced

Each acre of land thus planted contains 220 rubber trees When these trees reach the age of five years, a yield proof is taken That is, they are tapped to determine the

amount of dry rubber they yield Low yielding trees are eliminated and the number of rubber trees is reduced from 220 to 100 to 150 per acre

Maintenance of the rubber properties is itself a major problem After the rubber trees are developed, a leguminous plant of rapid growth and high resistance is planted, 100 holes per acre, and in a short time covers the entire planted area. This is done to check the development of weeds and also to aid in maintaining the humidity of the soil.

For the operation of its rubber plantations at Belterra and Fordlandia the Ford company is now employing about 500 men On these plantations, the company has 917 buildings, all designed to suit the various purposes for which they are intended Good light and water facilities are provided

Six schools are maintained with 13 teachers giving instruction to 498 children of both sexes Hospital services are excellent, there being two hospitals with a capacity of more than 120 beds, both with X-ray and ultra-violet ray equipment laboratories, pharmacies, excellent operating rooms, plumbing and sanitary facilities, and also completely equipped dental offices.

While Mr. Ford's primary object in setting up his Brazilian rubber plantations was to establish in the Western Hemisphere a source for a large part of the rubber consumed annually by his company, the research and experimental work that has been carried on might well prove of great value to Brazil, if rubber production on a high scientific plantation basis is to replace the more or less haphazard tappings of native jungle trees

The Brazilian government and commercial associations are now aware that the country must have good technical men if the rubber wealth of the Amazon valley is to be developed properly Undoubtedly, the experience which Ford has gained during the past few years will prove helpful, and co-operation between these agencies should help eventually to re-establish Brazil as an important source of the world's crude rubber supply

Pending such developments, the United States must continue to depend chiefly on supplies of natural rubber from the Far East, at least until sufficient quantities to meet our needs can be obtained from South American tappings and our own chemical rubber production

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Dry-Cleaning Grows Up

Chemistry Stimulates Growth of the Business Into a Great Nation-Wide Industry

COMMERCIAL dry-cleaning has, within the past two decades, entered the ranks of big business Improved chemicals used in various dry-cleaning processes, together with lowered prices made possible by these improvements, have raised the amount of cleaning done by 40 or 50 times in the past 20 years, and the amount spent for it from $55,000,000 to more than $600,000,000 per year

New synthetic solvents have wrought great changes in the business Non-flammable and non-explosive, they have reduced the hazards and cut the time of cleaning from hours to minutes Scientific cleaning with the new fluids has, indeed, brought many improvements in the quality of the service that is rendered It is this superior quality as well as speed of service made possible by the newer chemicals that has caused the prodigious growth of the dry-cleaning industry to 12,000 plants and 200,000 retail outlets.

A garment is measured before the cleaning, and it must go through the process without any shrinking or stretching or alteration of original shape

Until very recent years, a garment returned from the dry-cleaner's advertised itself by its distinctive odor In those days, petroleum distillates such as benzene and naphtha were commonly used, replacing gasoline which was used in still earlier days About 1929, chlorinated hydrocarbons were adopted for wide use. The use of one of these, carbon tetrachloride, required expensive equipment, however, so further research was necessary According to M Marean, writing in the *Du Pont Magazine*, equipment costs were reduced by a product called trichlorethylene which was first employed in 1931. Two years later the Du Pont Company made it available especially for dry-cleaning purposes This preparation is now used by cleaners in 40 states and in the District of Columbia. Another product, perchlorethylene, was later developed to meet the specific operating needs of certain systems

Rings left by the "spotting" process are removed by spray

When you send your soiled garments to a cleaning establishment that uses these modern fluids, you can count on the sure removal of spots made by oils, fats, greases, waxes, tars, and many other substances that commonly stain fabrics Another advantage of these solvents is that they work rapidly, requiring a minimum of mechanical action, thus saving much wear and tear on clothes. Colors become brighter, and materials regain their original feel and luster. The fluids do not cause shrinkage; silks and woolens retain their shape. As an

At the right, a quilted house-coat and several dresses are being loaded into a machine for cleaning in the modern manner with synthetic fluids. The process does an odorless job in far less time than was possible formerly. *Below:* Because hand finishing and shaping are important, an evening frock is hand-pressed after being thoroughly cleaned

extra precaution, all garments are carefully measured, before and after cleaning, to avoid any possibility of a change in shape

After the main cleaning, up-to-date establishments carefully scrutinize all garments to see if any spots remain, for no known dry-cleaning fluid will take out all stains. Water-soluble stains, such as sugars, fruit juices, and certain pigments, usually require after-treatment, but they are easily removed by special fluids, as the general process does not set them Then everything is thoroughly aired, and carefully pressed

When one realizes the tremendous number of articles produced in materials that may be dry-cleaned, the benefits of quality service are more fully appreciated According to estimates, some 550,000,000 men's suits go to the cleaners in a year, an average of a suit a month for 45,000,000 American men and boys. Women patronize the cleaner's facilities only slightly less, probably sending 400,000,000 garments a year to be dry-cleaned Millions of window curtains, costume accessories, and upholstery covers are also included

With the increasing adoption of modern methods and equipment, cleaning establishments are able to give all these garments thoroughly satisfactory attention, not only assuring their return in spotless, odorless condition and good shape, but preserving the strength of the materials through quick and careful handling

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BANANA FIBER

Hemp Substitute From Skins of the Fruit

THE Formosa Development Co, a Japanese organization, reportedly has succeeded in producing a hemp substitute from banana skins The concern plans to install 500 sets of a special fiber-extracting machine with which it hopes to produce 4,000,000 pounds of the substitute annually

TEMPERATURE PILLS

For Production Control in Wide Heat Range

IN some metal-working industries it is next to impossible to work out a temperature control of production, especially in the black heat range A new method, so simple that it can be entrusted to unskilled labor, has been developed by the Tempil Corporation of New York The method involves use of small wafers somewhat like enlarged pills, different types of which melt at different temperatures One of these, stamped plainly with its melting temperature, is placed on the surface of the metal, the temperature of which is to be controlled to an exact point. When the pellet melts, that temperature has been reached

Tempils, as these pellets are called, are safe to use and are not corrosive to any metals. They do not pit or leave objectionable stains which cannot be easily removed They are available in even hundred-degree ranges from 200 to 1500 degrees, Fahrenheit

Tempils are being used to prevent cracks in metal processing, to make stronger and safer welds; to indicate the approach of safe temperature limits in the manufacture of costly castings, forgings and machine equipment, for checking thermocouples; and for many other purposes where accurate heat control is essential

CUTTING TOOLS

Standardized, Lowered In Price

NEWSPAPERS recently gave the impression that, because of some real or fancied hook-up with German firms, production of Carboloy in this country would be so limited as to present one of the worst bottlenecks (how that word has been worn threadbare!) in our defense program Recent communications from Carboloy Company, Inc, indicate that Carboloy tools are not only available in numbers but have been standardized for faster production and much lower prices

Carboloy cutting tools, as now standardized, are designed to cover 80 to 90 percent of all applications for cemented carbide tools The simplified line comprises five styles in three different grades They will be carried in stock ready for shipment, completely ground and ready for use—including even the grinding-in of chip breakers on tools designed for machining steel. Mass production economies will most likely decrease the amount of brazing and grinding done by organizations who at present purchase Carboloy tips to make their own tools

A typical new standard tool costs only $1.85, as compared with a previous cost of about $5 84 in lots of one. In quantities of 50 or more, the tools now cost only 90 cents

BACTERICIDAL

Water, Milk, Beer May Be U-V Rayed

CONSIDERABLE research has been carried on in recent years in an effort to use ultra-violet rays to kill bacteria in water, milk, fruit juices, beer, and other liquids, and there

Experimental furnace used in the development of "Endogas"

is now some promise that these efforts may be successful, according to Dr H. C Rentschler, Westinghouse research engineer

Ultra-violet rays are already successfully destroying harmful bacteria and other microscopic organisms in hospitals, industrial plants, food shops, and many other places

"Water used for pre-cooling vegetables prior to shipment," Dr Rentschler revealed, "has been irradiated and the bacterial count reduced by 80 percent or more Tests have shown, however, that milk and fruit juices allow only slight penetration of the radiations, hence must be treated in thin films in order to achieve material reduction in bacterial count Beer has been found to be practically opaque to such rays

"Seven years of intensive research involving huge expenditures, have indicated that the use of ultra-violet radiation in the field of asepsis is likely to be the nucleus of a new branch of electrical industry, open a new chapter in the field of illuminating engineering, and prove to be of inestimable value in the field of public health and industry in general "

GAS BLANKET

Prevents Burning and Carbon Loss in Steel Hardening

A NEW gas blanket protects the "skin" of high-grade steel parts against heat-burn during the hardening process, according to J R Gier, Westinghouse research engineer. Such fine steel products as gears, springs, bearings, and metal-cutting tools would benefit from the new gas, which has been named "Endogas "

The gas mixture answers the demand by steel manufacturers for an inexpensive atmosphere that will prevent scaling and softening of steel surfaces under heat treatment between 1500 and 2300 degrees, Fahrenheit Loss of vital carbon from the steel can be prevented by the balancing effect of carbon in the new gas

"Endogas" is made by mixing air with natural gas, or other inexpensive fuel gas, and heating them to 1850 degrees in an electrically heated chamber By regulating the amount of gas and air entering the chamber, it was found, the proper amount of carbon could be sent along to the furnace to balance the amount of carbon in any grade of steel

"OILED" SILK

Synthetic Rubber Used On Silk, Rayon

ANNOUNCEMENT of a new fabric of innumerable uses, waterproofed with a coating of a synthetic substitute for rubber which has most of the natural product's advantages without its disadvantages, has been made by the Goodyear Tire & Rubber Company Pliosheen is the name of the new fabric.

Pliosheen fabrics, either of silk or rayon, are waterproof, odorless, tasteless, flame-resistant, contain no rubber or oil. The fabrics may be produced in the complete range of delicate pastel colors, deep tones, or clear white, all of which are sun-resistant and proof against cracking or peeling.

Lightweight Pliosheen fabrics are sheer and soft, but extremely strong and durable. They combine high soil-resistance with a facility for easy cleaning—a damp cloth being adequate for removal of most common stains Pliosheen fabrics may be printed without technical difficulties, making possible an unlimited array of patterns designed to harmonize or contrast with surroundings of any specific application

MILLING MACHINE

Univertical Bench Type With Swivel Head

A MILLING machine with a swivel head, graduated to a range of 90 degrees either way of the perpendicular, that can take over all the small jobs or about 90 per cent of the work that has to be normally done by machines costing five times as much, is announced by J. D Duffy & Son The Univertical high speed end milling machine is modern in every respect and capable of the most exacting precision work It is rugged, compact, powerful, it mills, drills, and bores Univertical mills an 8 by 16 die at one setting, and is designed for the use of cutting tools up to ⅝ of an inch. It can also be adapted to small grinding operations

A bench type machine with a base eleven by seventeen inches,

Swivel-head milling machine

it is powered by a heavy duty ¼-horsepower motor, has a four-speed V-belt pulley, permitting a range of from 850 to 3400 revolutions per minute, handling a broad latitude of intricate milling Its overall height is 37 inches. The maximum lift of the table to the end of the spindle is 10 inches with a work clearance of 6½ inches from the center of the spindle to the supporting column

STERILIZATION

Process Sterilizes Animal Fibers Without Damage

A NEW process for sterilizing animal fibers and killing any disease organisms on them without damaging the fibers has been patented by three research workers of the United States Department of Agriculture The new process will afford protection from such fiber-borne diseases as anthrax It will also be of particular value in preventing the spread of contagious disease The process can be used in hospitals, laundries, and dry-cleaning establishments for sterilizing blankets, clothing, and other articles that may come in contact with disease germs

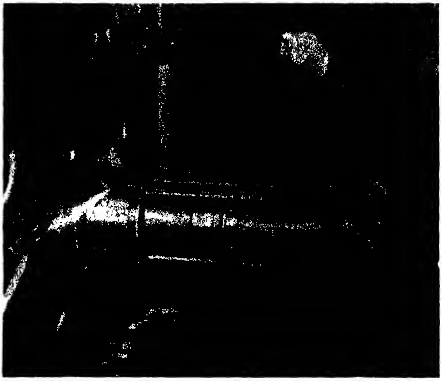
It works equally well with woven or raw fibers and with synthetic fibers made from proteins, such as the new fabric made from milk The process cleans, disinfects, and sterilizes without injuring the keratin which is the basis of all the animal fibers It is an improvement on current methods in the dry-cleaning industry and makes use of Stoddard solvent, a petroleum distillate of low flammability used in dry cleaning In the new process the solvent is heated

The newly patented process is adaptable for removing oils and fats from raw wools and permits degreasing and sterilization in one operation

GRINDER

Grinds Locomotive Pins In Place

THE problem of refinishing locomotive crank pins has been greatly reduced in time and expense by the Milwaukee Portable Locomotive Crank Pin Grinder, a product of Goetz-Voss Corporation The *Aluminum News-Letter* says that this grinder is mounted directly on the crank pin, and does a precision job without the delay of disassembling the drivers and putting the pin in a lathe



Grinding a locomotive crank pin without disassembling

The grinder consists of a lightweight aluminum frame on which are mounted two grinding wheels and the necessary precision controls to resurface the pin without damage

IODINE SHORTAGE

Germany Feels the Pinch of the Blockade

A CONSIDERABLE shortage of iodine has developed in Germany owing to curtailed imports caused by the blockade, and various measures have been adopted to restrict consumption and maintain supplies to meet indispensable requirements

Germany is dependent upon foreign sources for all of its iodine requirements Net imports expanded markedly in 1935, in consequence of a special trade agreement with Chile, to 228,500 kilograms from 57,600 in 1934. Subsequent to 1935, however, imports contracted steadily, falling to 126,800 kilograms in 1938, and 107,500 in the first seven months of 1939.

Residues, solutions, and other iodine-containing industrial wastes of the pharmaceutical industry plants producing inorganic or organic iodine-containing preparations, and especially the photographic chemical industry, are considered most prolific and advantageous sources for the recovery of iodine In the case o many waste and residue materials, recovery of 98 or 99 percent is possible Such recovery might be uneconomic in normal peace times, but costs now are subordinated to the imperative need of stretching existing supplies

PUNCTURE-PROOF

Inner Tube for Combat Vehicle Tires

ONE thing that puzzles the layman in viewing pictures of vehicles used in warfare, is the question of why their tires are not more often punctured The answer is that the usual type of pneumatic tire is often punctured in service by bullets Indeed, armies of the world have endeavored to find some way of gaining the advantage of such non-solid tires and at the same time preventing their destruction by enemy fire One of the ways of doing this is to make a sponge rubber tire This, however, has a number of disadvantages.

A new Bullet-Seal inner tube has been developed for the tires of war vehicles by the Seiberling Rubber Company. This tube has a double thickness of small cells filled with a plastic gum and lining

the usual tube wall. The cellular structure prevents the plastic from being thrown to the outer periphery of the tire, keeps it evenly distributed throughout the inner tube When a bullet penetrates the tire, the kneading action of the tire rolling over the ground kneads the plastic into the hole made by the bullet and effectively seals it Tires so equipped are said to have withstood successfully a burst of shots from 30-caliber and 50-caliber machine guns.

GERMICIDAL PAINT

ANTISEPTIC and germicidal paints have long been sought by researchers Foster D Snell recently stated that the use of oils to which chlorine or iodine have been added produces a paint which will kill the germ of typhoid fever and some others for nine weeks after painting, and shows some but not complete killing power after six years

FIRE WALL

Millions of "Fire-Walls" In Insulation

MILLIONS of microscopic fire-walls mixed in standard insulation constitute the newest challenge to flames which break out in one third

Testing fire-retardant insulation under blast of blow torch

of a million American homes each year. The fire walls are minute flakes of vermiculite, a non-metallic mineral which has its origin in mica Researchers in the Fir-Tex laboratories developed a means of expanding the vermiculite flakes with heat, and then interlacing the flakes with wood fibers.

The non-metallic mineral flakes prevent the spread of flames by forming millions of fire-stops in every insulating panel. Partitions constructed with the new lath-board, covered with poultry wire and plaster, prevented the spread of fire from one room of a house to another for more than an hour A partition of this construction also supported its normal, super-imposed weight during a fire for the same length of time

FORGE-WELDING

Heavy Welds Made Easily as Spot-Welds

"FORGE-WELDING" is a new process of heavy-duty electric resistance welding for spot welding heavy steel and iron sections heretofore considered impossible to weld with conventional equipment.

Resistance forge-welding consists, first, in applying pressure to the work, then, interrupted current, and, finally, super-imposing a hammering action on the electrode Under high pressure and with sufficient heat, the surfaces of work are brought into such intimate contact that when additional "impact-pressure" and intermittent heat are applied, a forged weld of superior quality is obtained

TRANSPARENT FABRICS

British Process Increases Gloss

A NEW process has been developed by Imperial Chemical Industries (England) for making fabrics transparent and impermeable to fluids, at the same time increasing their gloss The new process consists in impregnating the fabric with non-drying oil or semi-drying oil-modified polyhydric alcohol polybasic acid resins in conjunction with urea-formaldehyde condensation products It is claimed that the new process eliminates discoloration and tackiness when fabrics are subjected to heat treatment for short periods of time, also that it imparts excellent flexibility, soft handle, freedom from cracking or powdering and from objectionable tendering.

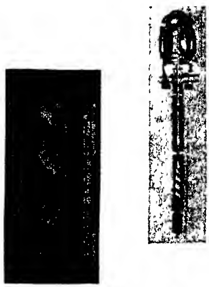
Dyed or printed fabrics may be treated as well as undyed material The treated fabric may be subjected to a mechanical finishing treatment, and may be printed with a nitrocellulose lacquer or with a pigmented composition. The fabrics may also be finished by the methods employed in the so-called "oil-silk" trade, such as coating with shellac, and material which has been treated locally may be finished by conventional processes

PUMP

Has Low Speed, High Capacity For Water

A PUMP which embodies an entirely new principle for pumping water, operates at the comparatively slow speed of 1760 revolutions per minute, and will deliver water against a head of 200 feet or more, has been developed by the Peerless Pump Division of Food Machinery Corporation It can be furnished in multi-stage units when service requires it It is particularly suitable for wells at dairies small farms, country estates, industrial establishments, and so on.

The operating motor is on the ground level A long connecting shaft projects downward to the actual pumping unit which is at the bottom of the well This unit is the unique feature of the pump



Left: Impeller unit of the high-lift pump described. *Right:* Sectional view of pump and motor

being described as a "helically contoured rotor." The rotating part is of stainless steel, and turns in a rubber stationary part having a similar shape which is called the stator. Water is lifted in amounts ranging from 300 to 5000 gallons per hour, with lifts up to 1000 feet by what the manufacturer calls "hypocycloidal" action.

CORN INTO INDUSTRY

News that the Department of Agriculture will open a laboratory in Peoria, Illinois, for the study of corn as an aid to defense implies an extension of work to industrialize corn which has been carried forward by many agencies for the past several years Corn is refined to create products that have dozens and dozens of uses aside from food, and now the possibility of using it to make synthetic rubber, plastics, fibers, and motor fuel will be explored

Last spring, yarn, buttons, poker chips, and laminated boards, made from a corn by-product, were exhibited at the National Farm Chemurgic Conference, hence the possibilities sought by the Department are not remote.

The by-product which has already produced the above mentioned articles is a protein, zein, which constitutes about 10 percent of the whole corn Its most practical use at the moment is for coating paper It resists scuffing and the penetration of greases and oils Zein films are tasteless, odorless, and non-toxic Hence they are useful for food containers Another use is in solid-color printing using aniline dyes. It is claimed that, using zein, fugitive dyes can be made more light resistant, that bleeding dyes can be made more resistant to water In a clear state, zein can be formulated to carry bronze and aluminum powders

There is such a thing as a zein plastic which can be molded and, when combined with other resins, can be used for impregnating and laminating Still a laboratory experiment is zein fiber made by extruding the protein in gelatinous form. It is claimed that its wet strength, elastic recovery, and abrasive resistance are better than those found in cellulose fibers

The manufacture of synthetic rubber from corn would be highly desirable. With petroleum being used as a base for synthetic rubber, and corn being pushed as a source of alcohol for fuel to offset any possible shortage in petroleum, why not short circuit this performance by making the rubber from corn and leaving petroleum to serve strictly as a fuel?

THE VERSATILE BEAN

Protein fibers are being derived also from soybeans Two companies have produced them in the laboratory, when last heard from, one of the concerns was going ahead with a pilot plant for further experimentation. But this is not the only particular which corn and soybeans have in common The soybean has become an industrial product with extraordinary rapidity and, if progress is maintained, it may yet nose out corn in relative importance, but this will take plenty of time and research. Oil from the beans goes into soaps, paints, and varnishes. The proteins in the meal can be made into parts for automobiles such as horn buttons, moldings, and small fittings, just like any plastic. Production of soybeans in this country has multiplied 17 times in the past six years and is still expanding. Hence, as technological competition with corn proceeds, so also does production of larger and still larger quantities of soybeans.

HIGH-SPEED CUTTING

A new alloy on the market is especially designed for fabrication into cutting tools. It is significant on two counts It represents another link in the long chain of developments aimed at the speeding up of metal cutting operations, it calls for a smaller tungsten content in its composition than is customarily found in high-speed steels. It does not fall within the classification of the tungsten carbides or tantalum carbides in hardness or cutting capacity, but is an all-purpose tool for general machine shop use, and is competitive with existing high speed steels.

Tungsten is one of those 17 strategic materials the use of which might be curtailed in event of real emergency, thus the new alloy is a real war-time product Its tungsten content is 5 percent as compared with 18 popularly used, and, according to claims, the reduction in tungsten does not in any way impair cutting qualities nor the ease of handling during fabrication It can be fabricated in raw form or finished tool without special precautions Hitherto, low-tungsten, high-speed steels have been subject to severe carburization during the hardening process, hence special care had to be taken to avoid destroying the surface of the steel during processing.

FLUORESCENT LAMPS

Credit the fluorescent with one solution to a knotty lighting problem of modernization When additional lighting is desired and no increase in wiring is possible because conduits are imbedded in construction and cannot be replaced with larger sizes, fluorescent lamps will give more foot-candles per given amount of alternating current

PERMANENT SUBSTITUTES

Out of effort expended to find substitutes for strategic materials may come products and processes superior in quality and lower in cost than those supplanted, hence they will outlast the emergency period and win a permanent place in industry This explains why it is good business to keep up-to-date with all new developments—it keeps one in front of the procession.

Packaging is one of the fields likely to be permanently influenced by current developments Now being sought are metallic substitutes for tin plating such as aluminum, silver, and tin-zinc combinations for can coatings There are also lacquers such as came to be used in beer cans Besides metals for packaging some interesting products are coming on the market which employ plastics and coated cardboards with and without re-enforcements Some will be seen on grocers' shelves very shortly

BERYLLIUM AGAIN

This metal likes to step into the spotlight (See March 1940, page 142) A bill has been introduced to make it a strategic material subject to Government control, and reports have it that the War Department has tested the metal successfully for parts in the Garand rifle There's a lot rumbling here and facts may come to light soon

— Philip H. Smith

What Are Pattee's Caves?

Are They the Remains of a Medieval Irish Monastery in New Hampshire, as is Claimed?

HUGH O'NEILL HENCKEN, M.A., Ph.D., Litt.D.
Curator of European Archeology Peabody Museum Harvard University

It is now widely realized that Columbus was by no means the first European explorer to investigate the continent across the Atlantic The Icelandic sagas tell of Norse navigators of about 1000 A D who visited North America, and it is no longer seriously questioned that these stories contain a good deal of historical fact Claims have also been put forward for early Portuguese, Welsh, and Irish explorers, but on much less secure grounds

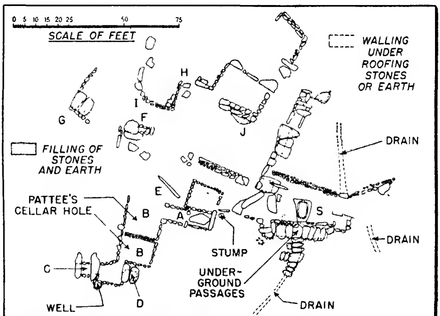
Especial interest has also attached to possible archeological traces left by these earliest trans-atlantic travelers But, up to now, though numerous discoveries have been reported, those acquainted with European buildings, inscriptions, weapons, and so on, of that time have either assigned the objects to a much later date than that attributed to the early voyages or have suspected fraud Still, one never knows at what moment the first genuine discovery may turn up

One of the most recent claims of this kind has been put forward by the distinguished antiquary, Mr William B Goodwin, of Hartford Connecticut, who has suggested that a curious group of ruins known locally as Pattee's Caves, near North Salem in southeastern New Hampshire, is an Irish monastery In his view this monastery would have been founded by sailor monks like those who settled in Iceland before the Norse occupation in the latter part of the 9th Century.[1]

The largest ruin, marked *B* in both plan and drawing, appears to be the cellar-hole of a New England farm house Around it are remains of numerous rough masonry buildings with only a few patches of mortar Some are subterranean or semi-subterranean and are roofed with huge flat stones The walls also contain many big stone blocks

The most remarkable structure is the so-called "Y-Cavern" (marked "Underground Passages" on the plan), a narrow, branching, subterranean passage lined with stone walls, roofed with flat slabs and provided with numerous niches and a long drain Close to the Y-Cavern is a large flat stone marked *S* on the plan Around its upper surface a little way from the edge there is cut a narrow channel with an outlet at one end obviously designed to catch and drain off some liquid It has been called the Sacrificial Stone, though, needless to say, sacrifices requiring such equipment can hardly be associated with the ritual of the Church! Comparison is suggested with the old New England lye-stones These have such channels, though much smaller in diameter; a hogshead of ashes used to be put in the middle and water seeped through to wash out the lye. Possibly the Sacrificial Stone may be something of this sort. But to interpret Pattee's Caves as a whole is very difficult They might conceivably have served as the out-buildings of a farm, but their size and number seem out of all proportion to the house which is known to have stood at the point *B* from 1832 to 1855, and which was not large

The idea that the site was really an Irish monastery as old as the 9th or 10 Century, A D, has been suggested by a series of references in the Icelandic sagas to a country across the ocean called White Man's Land or Ireland the Great These sagas are long prose histories of the Norwegian families who began to settle in Iceland in the 9th Century, but they were not committed to writing before the middle of the 12th Century Some of them describe undoubtedly historical voyages to Wineland the Good (North America) about the year 1000 In these stories also occur the references to White Man's Land or Ireland the Great This place was said to lie west of Ireland, and there are hints that it was known to or occupied by Irishmen On the whole, however, the accounts of White Man's Land or Ireland the Great may be considered as folk-lore rather than history



Illustrations courtesy *The New England Quarterly*

A plan of Pattee's Caverns, near North Salem, New Hampshire, which some regard as remains of a monastery, others as an eccentric's work

[1]The writer is greatly indebted to Mr Goodwin for every kind of assistance in examining these ruins and their history, as well as for the accompanying illustrations and it is very much to his regret that he cannot agree that these structures represent a pre-Columbian settlement

A fuller account will be found in *The New England Quarterly* Vol XII, pp 429-442

A panoramic drawing of the same group of structures. The letters correspond in each illustration

The view that the site was really an Irish monastery was also suggested by the presumed likeness of Pattee's Caves to certain ancient structures in Ireland Now, in Ireland, as in many other parts of Europe, there are early stone buildings of several kinds and of several different periods But, despite a few superficial and generalized resemblances, the caves are not closely comparable to anything in Europe If one examines Irish monasteries of the early period, one finds that there are four features common to most of them surrounding walls called cashels, small rectangular churches, round towers, and numerous contemporary graves often accompanied by inscribed and ornamented tombstones Not one of these occurs at Pattee's Caves. It is also safe to say that the New Hampshire site differs equally widely from Norse sites It may further be added that the caves bear equally little resemblance to anything ever built by Indians

What can local history tell us of these ruins? One occupant is indeed fairly well known. He was a somewhat dubious character called Jonathan Pattee, who committed a robbery about 1826 and eluded search by fleeing to this place About 1832 to 1835 he built the farmhouse whose cellar-hole is shown here as *B* in the drawing and plan, and here he lived with his large family until his death in 1848. In 1855 the house was burned down and shortly afterward the site was used as a stone quarry

Tradition also can add something to historical fact, though as is often the case, it complicates rather than clarifies the issue The people of North Salem, including some of Pattee's descendents, concur in ascribing all the buildings to Pattee himself But one of Pattee's sons is known to have said that his father did not build the structures, but "improved" them This expression might mean in old New England usage merely "occupied and kept up" Both of these traditions may contain a part of the truth.

Mr Goodwin, mentioned earlier, has done much to excavate and repair the Caves and in the course of this work a quantity of broken china and other objects dating between about 1790 and 1850 has come to light Assuming that the Pattee family probably arrived with some old or second-hand household equipment, these fragments are probably the remains of their possessions, or possibly in a few cases those of some immediate predecessor on the site. But despite suggestions to the contrary, nothing has turned up to indicate early Europeans.

There is, nevertheless, one find that may indicate that at least a part of the Caves was built before Pattee's time. Behind structure *A* there is a white pine stump 27 inches in diameter which apparently started to grow after structure *A* was built. The stump is now so rotten that its rings cannot be counted, but a comparison with the diameter and number of rings of other newly cut pine stumps in the vicinity leads to the very generalized conclusions that probably the tree began to grow before Pattee's arrival in 1826, also that it is highly improbable that it began to grow before the *Mayflower* arrived in 1620. Hence the stump suggests that structure *A* may have been built before Pattee's time Indeed, this might explain why Pattee went there in the first place when he was a fugitive from justice But it certainly does not prove that Pattee's Caves were built prior to the white settlement of New England in the early 17th Century Hence one is forced to the conclusion that they were built after the white settlement.

Who, then, could have built Pattee's Caves and why? None of the objects found by Mr Goodwin seems to be older than 1790 The age of the white pine stump, which seems to be later than structure *A*, is not necessarily inconsistent with this, since it can be fixed only within broad limits But it would indicate that perhaps at least structure *A* was built before—but not very long before—Pattee's appearance in 1826.

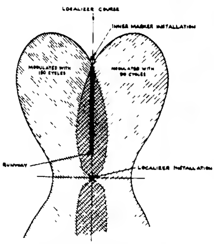
Pattee, aided by his numerous family and perhaps a team of oxen, would have had no special difficulty in building the caves. What he built them for is another matter. The people of North Salem say that he was crazy.

Blind Landing

Exhaustive Tests Show Effectiveness of System Being Installed at Six Airports

ALEXANDER KLEMIN
Aviation Editor, Scientific American
In charge Daniel Guggenheim School of Aeronautics, New York University

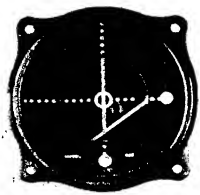
As a result of competitive bidding, and technical examination by the National Academy of Sciences, the blind landing system of the International Telephone Development Company has been accepted by the Civil Aeronautics Board, and is being installed at six of the principal airports of the United States La Guardia, New York, Municipal Airports at Chicago, Cleveland, and Kansas City, Mines Field, Los Angeles and Meacham Field, Fort Worth If this blind landing system proves as effective in service as it has in exhaustive tests, our airlines will become almost "weatherproof"



How overlapping horizontal radio field patterns produce the runway localizer course

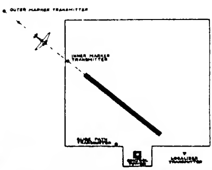
Radio navigation, with radio ranges, markers, radio compass, and so on, has been available for a number of years It makes it possible for a transport plane to fly to the vicinity of its destination under almost any weather conditions The more difficult problem is that of actually landing the airplane safely under conditions of low visibility In radio navigation, low frequencies have proved fairly satisfactory. In blind-landing systems, however, high frequencies of the order of 75 megacycles are supreme and indispensable

Why are short waves so overwhelmingly preferable to long waves? The reasons are clearly defined With short waves, static is reduced to a minimum High directivity is an absolute requirement, and the radio signal must not be disturbed by ground irregularities, it is only the ultra short waves that seem to be almost immune to the presence of power lines, rivers, mountains, and other irregularities on the surface of the earth Antenna arrays are much cheaper and smaller with short than with the long radio waves



Cross Pointer Indicator

The main requirement of the blind-landing system is to provide a well-defined radio path, easy to locate, and one that will guide the aircraft in a natural glide to the approach end of the runway To give the pilot ample time to orient the airplane in preparation for the landing, he should be able to locate the glide path some distance from the airport. The pathway meeting these requirements is analogous to a long chute sloping towards the airport. The pilot's task is to keep the landing wheels within the chute and on the floor of the chute, so to speak. Such a chute is provided by a path of constant electric field intensity beginning at a point about five miles from the airport boundary. A glide-path transmitter at the airport furnishes the ultra high frequency power for this service and a specially designed transmitting antenna establishes the constant field intensity along the path



Layout of blind-landing equipment for use in one direction

The sides of the chute, providing lateral guidance, are given by overlapping radio fields A runway localizer transmitter and antenna installation is located off the end of the runway at the airport. Two overlapping horizontal field patterns produce the localizer course Each pattern is modulated with a different audio frequency and the course which the ship follows lies in the overlapped region where a signal of equal intensity is received from each pattern.

To take advantage of the path of constant field intensity and of the runway localizer, the pilot need only watch a Cross Pointer Indicator instrument in his cockpit. The

General impression of the blind landing system

vertical needle provides him with lateral guidance. The horizontal needle indicates altitude relative to the glide path. The pilot has only to control his ship so that the two needles are at right angles to one another to make a perfectly normal glide.

For further help to the pilot, two beacons are provided, located on the ground along the glide path, each projecting a narrow radio beam straight upward, to be received by the pilot as he passes by. One beacon is located two miles from the airport boundary and the other is at the airport boundary. The inner and outer marker beacons provide both audio and visual indications for the pilot. The general arrangement of the blind-landing system is shown in our illustrations. In one of them there is shown a typical layout of the four transmitters relative to the runway as installed for a single landing direction An airport can be equipped for any number of landing directions but the maximum is ordinarily four.

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AUTOGIRO

ONE of our photographs shows the new Pitcairn direct-take-off autogiro achieving its remarkable initial "jump-off" The giro was placed about eight feet from two poles, 17 feet in height, which were interlaced with ribbons like a steeplechase hurdle The path of the machine in space is indicated by the broken line.

The PA-36 is not only of the direct-take-off type, but also of the direct control type, in which control is achieved by tilting the rotor fore-and-aft or laterally, so that perfect control is available even when the giro has no forward speed While direct control offers many advantages, bumps and other conditions, in earlier designs, transmitted rotor loads somewhat unpleasantly to the pilot's stick These difficulties have now been removed by placing the axes of the flapping hinges close to the center of rotation.

The technique of the take-off is of considerable interest. Before the jump, through a hydraulic system, a single control lever locks the wheel brakes, sets the rotor blades at zero pitch, and engages the rotor clutch for power transmission to the rotor. Then the pilot advances the throttle, and since the blades are at zero pitch and in the position of minimum drag, they are over-revved to some revolutions per minute By the use of the same hydraulic device, the rotor blades are then set at their normal pitch, the transmission clutch is disconnected from the rotor, and the forward propeller receives a greater torque The rotor, now at lifting pitch but with a speed exceeding normal, exercises a lift greater than the weight of the aircraft Hence the jump, which continues until the blades have lost kinetic energy and speed, with rotor turning at about 170 revolutions per minute

Above. **The PA-36 autogiro, showing engine compartment with cover removed.** *Below:* **Line shows vertical take-off**

An interesting feature of the new machine is a fairing of rubberized fabric which covers the hub and blades, reducing hub drag and eliminating end losses at the blade roots The blades may be folded back over the horizontal tail surfaces of the machine on the ground, to reduce hangar space required or to permit the machine to be driven down a highway.

Our second photograph indicates the general mechanical arrangement of the machine The 175-horsepower air-cooled Warner engine is placed behind the two occupants so as to improve vision and facilitate installation of the ground drive A drive shaft from the engine to the propeller passes forward on the side of the cabin There are clutches for the front propeller, for the rotor starter, and for the ground drive —*A K.*

SAFETY

When Taking-Off From Sand

WE have often quoted from the *Engineering News Letter* of Aero Insurance Underwriters. Jerome Lederer, Chief Engineer of this company, has now become Director of the Safety Bureau of the Civil Aeronautics Board, and we consider this a magnificent appointment The last *News Letter* written by Mr Lederer contains as usual at least one useful tip for flying safety Thus, he points out that revving up the engine on beaches or gravel surfaces results in a sand blasting of the blade, as small stones, sand, and so on, are sucked up into the airscrew Therefore, the engine should be revved up on an area free from gravel. If take-off must be made from sandy or gravel areas, the sand blasting effect can be reduced by opening the throttle slowly so that the increasing forward speed counteracts the suction from the increasing revolutions —*A. K*

Plastic Metals

New Knowledge Provides Science with Better Answers about Metals' Inner Nature

SIDNEY J. FRENCH
Assistant Professor of Chemistry at Colgate University

WE LIVE in an age of modern plastics There are plastic buttons, plastic door-knobs, plastic combs and plastic clothes, there are plastic toys and plastic dinnerware, plastic pens and plastic radios. With all these remarkable products we are likely to overlook the greatest plastic of them all—one known to man since time began—the plastic metals Old as these plastics are, it is only in recent times that we have begun to understand the true nature of their plasticity and its control What are some of the properties of these plastic metals?

To find this out let us enter the

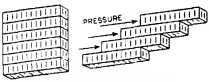

Figure 1. Left **Diagrammatic illustration of crystal block structure of a metal crystal.** *Right* **The crystal blocks echelonned**

G-man's world for a brief moment A murder has been committed Officers at the scene of the crime pick up an empty revolver It is evidently the gun with which the crime was committed, but whose gun? The weapon is carefully examined for identification marks but the registration number has been laboriously filed out by the clever criminal

Clever? No! The criminal has wasted both time and energy The gun is taken to an expert metallographer who quickly swabs the filed spot with a suitable etching agent In a moment the hidden numbers reappear once more The magic of the etch has done its work, the numbers are read and the first step in the solution of the crime is well started.

What is the story back of this magical production of numbers where there were none before? Why does a simple acid solution produce numbers on a smooth piece of metal? It is all part of the story which the metallurgist calls the work-hardening of metals It is a story of plasticity

A friend of mine is an amateur silversmith, and a good one at that He tells me that, as he hammers away at his silver, shaping his *objet d'art*, the metal gradually becomes hard and brittle Soon he must stop and heat up the object, not to its melting point nor even till it softens, but merely to about 400 degrees, Fahrenheit, whereupon the silver becomes pliable and ductile once more So he goes alternately hammering and heating till the object is finished True there seems to be little connection between silversmithing and restoring the registry numbers of a gun with an etching agent, nevertheless, both are phases of the same process, the work-hardening of metals

The questions the scientist is seeking answers to are, first, what causes metals to harden and become brittle when they are worked or hammered in the cold, and second, why does mere moderate heating cause these same metals to regain their plasticity once more? Until recently, science has been able to offer no explanations beyond the mere statement that it is "the nature of the beast" to behave as it does. Now, however better answers are being found as science probes into the intimate structures of metals

IT has long been known that metals are made up of tiny crystals which can be observed under the microscope in a properly prepared specimen. Beyond and within these tiny crystals, where the microscope cannot penetrate, lie most of the answers to work-hardening. Each microscopically visible crystal is, in turn, made up of myriads of infinitely smaller "crystal blocks" or units, whose structures can be inferred by their effects upon the deeply-penetrating X-ray Even then we have not reached the ultimate sub-division of the crystal, which is the infinitesimally tiny atom. These atoms are the single bricks, just as the crystal blocks are the stories, and the microscopic crystals are the skyscrapers of this tiny crystal world. Just as the stories of a skyscraper rest upon one another in uniform pattern, window above window, so too, these crystal blocks rest upon one another, atom above atom, in rows and columns, in regular pattern throughout the entire crystal (Figure 1, at left)

Another analogy: the atoms are the soldiers of a mighty company lined up in columns of fours Within the company are the squads, each squad of eight representing

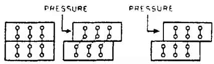

Figure 2: **Illustrating elastic deformation.** *Left:* **Moderate pressure, atoms stay within recall.** *Right* **A permanent deformation**

a crystal block, a unit in its own right, but nonetheless an integral part of the greater unit Each atom is alined with others of his block and each block is alined with all others of the entire crystal This is the perfect crystal seldom found in practice

Within the framework of the company, each squad exercises a certain degree of independence There is an old formation in military circles called marching in echelon At the given command each squad leader moves his squad obliquely to the right (or left) till it overlaps the squad ahead The column is said to be echelonned in depth This is just the sort of thing that happens when great pressure is placed on a metal crystal Each crystal block slides past its neighbor till the whole crystal is echelonned in depth (Figure 1, right) The scientist calls it plastic deformation. If, however, the pressure is moderate, there may be no slipping beyond recall, but only a warping of atoms from their original positions When the pressure is released, the atoms spring back into formation once more and the crystal is intact (Figure 2, left) This is called elastic deformation.

It is a well-known fact that tall buildings lean out of alinement during strong wind, yet return promptly to normal position when

the wind subsides, a good example of the elastic deformation of the metal framework. But suppose the construction were such that each story were simply set loosely upon the one below. Then it might be possible to move each story over (provided the building didn't fall down) till an upper window stood directly above a window which was formerly one space to the right. This is the sort of thing the scientist means when, in referring to metal crystals, he speaks of plastic deformation (Figure 2, right).

While all this may offer a suitable explanation of why metals may be flattened or drawn, it offers no explanation of why they harden and become brittle in the process It is here that science steps in with its theories, none of which can yet be finally verified

One theory of work-hardening presumes that in the slipping of crystal blocks past one another, atoms from the surfaces of each are torn loose, to be scattered indiscriminately along the slip-planes between the blocks These mixed atoms, forming what the scientist likes to call an amorphous state, act as a sort of atomic glue causing the blocks to stick together (Figure 3, left) The farther the blocks are shoved, the greater is the accumulation of this atomic glue and the greater becomes the resistance to further slip If the pressure is too great the crystal is ruptured between blocks, tearing the metal apart

A second theory explains the phenomenon in a somewhat different way As the blocks slip over one another, tiny fragments are torn loose to lodge along the slip-planes Crystal blocks under great pressure break on the crystal fragments which have so effectively sanded their smooth gliding planes (Figure 3, center).

Still a third theory gives another answer to the problem It assumes that, in the process of slipping, the blocks themselves become bent and corrugated (Figure 3, right). Try to slide two pieces of corrugated iron over one another in a direction at right angles to the ridges and valleys and you have the virtual answer which this theory, known as the lattice distortion theory, gives to the problem As slipping progresses, the blocks become more distorted till further slipping is impossible. The limit of plastic deformation is reached.

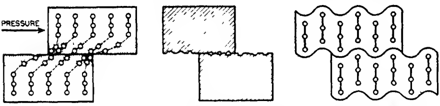

Figure 3. Left. **Illustrating, diagrammatically as before, the "atomic glue" theory.** *Center* **The fragmentation theory.** *Right.* **The corrugation theory**

THUS far, we have considered only a single microscopic crystal. In even a small piece of metal, however, there are thousands of these crystals, each, by chance, with its crystal blocks lined up in different directions, at all possible angles to abutting crystal neighbors (Figure 4, *a*) It is like a jumbled pile of glass bricks, except that there are no empty spaces Suppose we shove the pile of glass bricks. Some are pushed forward, some push their neighbors sidewise, or even backward So it is with a pack of metal crystals when pressure is put on the metal some crystal blocks slide in line with the pressure, these in turn force the blocks of abutting crystals to slide sidewise up, or down (Figure 4, *b*) The final net result of this jumble of slides is the same whether the pressure is a push, a pull or a hammer stroke, each crystal block is forced to its limit of plastic deformation Then the metal breaks

Yet, after heating, the metal is once more pliable without having lost the form into which it has been hammered. What happens to restore the pliability?

It was noted earlier that the striking tendency of the atoms is to line up in rows and columns, even when crystal blocks are shoved past one another. But this does not always happen Often, an unhappy atom in the face of one block is forced to stop midway between two atoms of an adjacent block Like the unfortunate neutral—between two nations at war —this atom strives to get into two positions at one time. Also, like the neutral, it is under a high state of strain But the pressure from all sides is too great, the atom cannot move, the strain remains (Figure 5) On the surface of the metal however, the case is different there is no external pressure and misplaced atoms can line up in the nearest row. The surface strain is relieved

Now we are ready to solve the apparent mystery of the gun registry numbers. These numbers are stamped into the gun under high pressure Filing has merely removed the unstrained surface around the numbers but it has not affected the deeply strained crystals below the numbers The etching agent removes a thin layer above the strained crystals and then attacks the crystals themselves—attacks them more vigorously than the unstrained neighboring crystals Hence, the strained crystals underlying the numbers are most deeply etched and the numbers are reformed

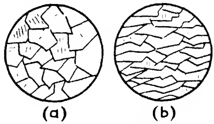

Figure 4. **Drawing (a) shows normal crystal structure, blocks lined up in different directions. (b) shows effect of cold working**

A metal under internal strain is a far from satisfactory product The first job of heating is to relieve this strain Atoms, even misplaced atoms in metals, are constantly in rapid vibratory motion, the higher the temperature, the greater the vibration There comes a point in the heating of a metal when the vibration of the atoms is so great that, in spite of the internal pressure, misplaced atoms can swing themselves back into line once more This heating, the metallurgist properly calls stress relieving or recovery The misplaced atoms have recovered their rightful positions The temperature required for this process is not high Indeed, some metals "recover" at room temperature This simply means that they do not harden or become brittle when worked, for their atoms spring back into place as soon as the working stops Tin and lead are among such metals

Simple recovery, however, does not restore pliability to the metal The crystals are still elongated and distorted, as can well be observed

under the microscope If the metal is heated somewhat hotter, a profound change, which can be followed with the microscope, begins The distorted, elongated crystals begin to disappear, to be replaced by new, small, well-formed crystals. The amorphous atomic glue, the angular, braking fragments, the roughened corrugated crystal

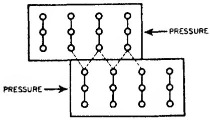

Figure 5· **Illustrating one cause of internal strain: atoms which "can't make up their minds." They do when the heat is put on**

blocks have been swallowed up in the new crystals New glide planes have been formed Once more the metal is willing to be flattened, drawn, or pulled to the limit of its plast-ability

Thus does a metal pass through the phases of work-hardening and annealing A knowledge of plastic limits, of recovery temperatures, of recrystallization temperatures, is of the utmost importance to the practical worker in metals He knows them by instinct But the scientist is interested in more in the factors that motivate and promote these unique and fascinating changes in metals He has learned much and he has much yet to learn As he answers the whys of metal behavior, the ancient art of metal working turns into the modern science of plastic metals

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LESS FRICTION

Barium Film Lubricates Bearing In A Vacuum

A DISCOVERY that a metal film may be used to lubricate bearings in a vacuum where ordinary lubricants are useless is reported in the September issue of the *Journal of Applied Physics* by Zed J Atlee, Jack T Wilson, and James C Filmer, engineers of the General Electric X-Ray Corporation

Vaporizing metallic barium to place a film on the steel ball bearings of a rotating anode target in an X-ray tube greatly reduced the friction, they reported Rotating anode bearings in X-ray tubes used for high power, high speed diagnostic work have been operated hitherto without lubrication

Use of the barium as a lubricant made possible a tube which not only operates much more quietly but also is one in which the bearing life is much longer. A number of other metallic films were found to have possibilities as lubricants but barium proved to be the most successful.

In one experiment an anode bearing was observed to have a sound level of 87 decibels, a speed of 3100 revolutions per minute, and a coasting time of 12 seconds The barium film was then applied In 30 seconds the sound in the same bearing was reduced to 68 decibels while the speed rose to 3560 revolutions per minute and the coasting time rose to eight minutes

Under the normal operating temperatures of the X-ray load, the film will effectively lubricate an anode bearing for 50 to 100 hours of rotation.

"OILING" OIL

Wear-Prevention by Means of Addition Agents

THE wear-prevention qualities of lubricating oil can be multiplied as much as 17 times by the addition of two groups of chemical agents, scientists of the Emeryville, California, laboratories o' the Shell Development Company recently reported to the American Chemical Society

"There are two major groups of agents," these research workers said, "which, when added to lubricating oil, are able considerably to reduce wear These two groups have quite different functions

"The first group consists of organic compounds whose molecules take the form of long threads which are able to attach themselves by chemical forces, arising from the special structure of the molecules, to the surface of the metal. These compounds greatly increase the tightness with which a film of oil is held between the moving metal surfaces, even under high loads.

"However, the favorable effect of such agents is lost unless the metal surfaces themselves are highly polished and maintain their high polish in service. Even the best polish attainable by mechanical means leaves the surface covered with microscopic irregularities or roughnesses, and it is in the removal of these that the second type of addition agent finds its usefulness.

"Addition agents of the second type have the property of combining, under the influence of the heat generated by the rubbing surfaces, with the surface layer of the metal to form low melting alloys. The result is that when the tiny hills on the surfaces become engaged with each other, isolated spots of very high temperature are produced at the points of contact which cause the surface layer of low-melting alloy to melt and flow just at those points where the hills come into contact

"These chemical polishing agents are so chosen that the whole surface of the metal does not melt, nor even grow hot, but only the minute projecting roughnesses In this way the surface of the metal is polished to a high degree while in motion and by virtue of its motion

"Laboratory tests using highly sensitive apparatus, capable of reproducing wear measurements within an accuracy of 1 percent, have shown that the wear properties of a highly refined white oil, for example, can be improved ten times by the addition of the chemical polishing agents alone When both polishing and 'film holding' agents are used this factor has been increased to 17 times"

SOUND ENERGY

Noise Speeds Chemical Reaction

SOUND, without assistance from any other source of energy, can speed up the rate at which a chemical reaction takes place, Dr. Walter C. Schumb of Massachusetts Institute of Technology has reported to the American Chemical Society

Although it has been assumed by scientists that an intense sound has an accelerative effect on certain chemical reactions, Dr. Schumb is the first to prove that this increase in activity takes place because of the noise, as such, and not because of heat energy transmitted by mechanical vibrations.

Dr. Schumb and Mr. Edmund S Rittner showed that sound energy produced by a rapidly vibrating nickel tube partly immersed in a solution is able, of itself and apart from any thermal effect, to hasten the speed of a chemical reaction. They carefully balanced out the heat effects resulting from the me-

chanical vibration of the solution so as to be able to establish the reality of the effect of the sound *per se*.

"We were not at this time attempting to widen the scope or applicability of this form of energy or to find new uses of the vibrating unit," Dr Schumb says. "Many such applications have been reported hitherto, such as the partial sterilization of milk, the preparation of various kinds of emulsions, including photographic emulsions, and the bringing about of certain oxidation processes The physical erosion of metal brought about when a liquid and a metal are in relatively rapid motion with respect to one another, as in the pitting of ship propeller blades, pump impellers, and hydraulic turbines, is of practical importance and has been studied with the same type of apparatus"

STRAIN GAGE

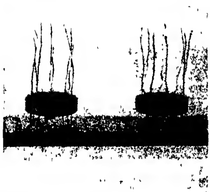
Small Device Permits Study of Moving Parts

STRESS and stress distribution in such structures as the complicated members of airplanes, automobiles, railroad equipment, and bridges may now be determined and analyzed by a new strain gage This device makes use of the fact that strain changes the electrical resistance of metallic conductors It combines the accuracy of the testing laboratory with simplicity, convenience, and reliability It is simply cemented to the member to be studied, has no clamps, no moving parts, no inertia distortion, and no hysteresis Once in place, a strain gage may be left permanently installed for months during which a complete study of the part on which it is attached may be made.

The SR-4 Metalectric strain gage is simply a small grid of specially selected metallic conductors, its overall dimensions are ¾ by 1⅜ by ¼ inches. It may, therefore, be installed in places inaccessible to other forms of stress analyzers. In the accompanying photograph, the brass bar shown screwed on top is used merely for rigidity and is removed once the strain gage has been cemented into place

This new gage is particularly suited to machinery operating at high speeds because it has no detectable inertia effects and has been tested at frequencies of over 30,000 cycles per second, with no indication as to any upper limit to the response

An SR-4 strain gage



Strain rosettes

An indication of the wide range of application of the Bonded Metalectric method of strain measurement is in its application to the two-dimensional strain rosette problem The strain rosette is a highly simplified instrument which is cemented as a unit to the surface under investigation It contains four gage lines at 45-degree angles to each other, each of ¾-inch gage length By connecting, in turn, the leads from the rosette to the control box, the amounts and directions of the principal stresses (axes of the stress elipse) of any surface can be accurately and rapidly determined

SCAVENGERS

Gold Fish Do a Job For Research

THREE gold fish, costing 30 cents, have been put to work in General Electric's plastics research laboratory, doing the work which took seven hours' time of a chemist each week Since the fish find food in the work they do, the upkeep or maintenance is without cost.

A large glass jar is used in the laboratory for keeping a constant temperature bath for measuring viscosity in plastic materials. The inside of this jar had a tendency to collect scum, making the glass opaque Since it was necessary to make frequent observations of what took place in glass tubes inserted into this bath, the jar had to be emptied once or twice a week and scoured The scum stuck, and it was a tedious job to clean it Different acids were tried, but they didn't work Then three gold fish were put into the jar They took to the scum like a kitten takes to milk, and within two or three days the scum had all disappeared That was three months ago, and since that time it has not been necessary to clean the bowl

DISAPPOINTED

Prospector Finds Remarkably Fine Mineral; Shrugs

WHEN a Mexican prospector in the southwest stumbled on a vein of vitreous material, he leased the deposit to others, since this was not the material for which he was looking That vein has turned out to be one of the biggest calcite deposits ever discovered Around the borders of the schist, crystals of calcite up to 1½ feet across grew out into the clay bed

Nothing like this had been discovered since the opening of the Iceland spar mine at Helgustadir When the operators of the new domestic mine approached Bausch & Lomb, largest user of optical grade calcite, the company contracted to take the entire output of optically suitable crystals The result has been spectacular More than 500 pounds of fine spar crystals were taken out within a period of three months Imported crystals have averaged between two and four ounces and not more than 200 or 300 pounds a year have ever entered the United States none in late years The new source, the first of any consequence found in America, adds additional protection of the optical industry

The most important use of calcite is in the construction of Nicol prisms which are used in many scientific instruments designed both for laboratory purposes and as an aid to industry in checking the uniformity of its products

The Origin of the Earth

Astrophysicists Still Are Unable to Solve This Near-at-Home Problem with Finality

HENRY NORRIS RUSSELL, Ph.D.
Chairman of the Department of Astronomy and Director of the Observatory at Princeton University Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington

It is almost two years since Bethe published his beautiful explanation why the Sun keeps on shining Hydrogen supplied the fuel, helium formed the ashes, and carbon and nitrogen kept the process going by a chain of reactions at the end of which they were formed anew The only doubt that could have been raised at that time was that two of the six steps in the cycle had not yet been observed in the laboratory, but had to be inferred from the theory of atomic nuclei

Since then, both the missing links have been supplied by experiment Ordinary nitrogen nuclei, bombarded with protons, have been observed to form a light, radioactive isotope of oxygen, according to the equation $N^{14} + H^1 = O^{15} + \gamma$ (where γ represents energy emitted as a gamma-ray). These oxygen nuclei emit positive electrons, and turn into heavy nitrogen, N^{15}

This isotope forms about one part in 260 of ordinary terrestrial nitrogen It would be hard to study were it not for the recently developed methods of concentration which produce small amounts of nitrogen compounds greatly enriched in the heavier atoms Bombarding these with protons it has been found that the reaction predicted by Bethe

$$N^{15} + H^1 = C^{12} + He^4$$

is not only possible, but exceedingly probable Every direct hit of a proton on a heavy nitrogen nucleus breaks it up The alternative reaction $N^{15} + H^1 = O^{16} + \gamma$, in which oxygen is formed and radiation emitted, is theoretically possible, but, if at all like other radiation-producing processes, must be very much less likely to occur Bethe estimates that it will happen in only one case in a million

Bethe's anticipations have thus been confirmed in detail, and his theory now rests entirely on observed facts His original predictions were, indeed, too cautious, for both of the nitrogen reactions are more probable than he originally estimated Under the conditions which prevail at the Sun's center, the average life of an N^{14} nucleus, before a collision builds it up, is estimated by Bethe as 4,000,000 years That of N^{15} is only 20 years For ordinary carbon, C^{12}, it is 2,500,000 years, for C^{13}, 50,000 years He points out that "these values may easily be wrong by a factor of about three either way" on account of the uncertainty in passing from the effects of the few, but violent, nuclear collisions which are produced in our experiments to those of the less violent, but more numerous, collisions inside the Sun

The later results are astrophysically more satisfactory than the original estimates, according to which the life of N^{14} was 50,000,000 years On this basis, it was necessary to assume that nearly 10 percent, by weight, of the Sun's interior consisted of nitrogen in order to account for the production of energy at the known rate, at the central temperature and density, which can be pretty well estimated The new data reduce the calculated proportions of carbon and nitrogen each to about 0.5 percent—which accords much better with the general spectroscopic evidence According to the new calculations, however, the abundance of N^{15} in the Sun should be only 1/200,000 that of N^{14} The heavier isotope is about 800 times more abundant than this on the Earth

This would raise serious difficulties, if we had strong reasons for believing that the composition of the inside of the Sun and the outside of the Earth were exactly similar. But there is no such reason, except for the assumption that the Earth was in some way formed out of matter expelled in some way from the interior of the Sun, or of some star of similar composition, and this assumption, so long accepted, is now in very serious difficulties

The high terrestrial abundance of heavy nitrogen does not stand alone Heavy hydrogen — deuterium—is approximately 1/5000 as abundant on Earth as the lighter isotope But the deuterium nucleus is by far the easiest of all to disintegrate In the Sun's interior practically no deuterons should survive Bethe estimates their number as certainly less than 10^{-18} that of the protons—one to a billion billions Moreover, terrestrial rocks contain small, but by no means negligible, amounts of lithium and beryllium, whose nuclei are the next easiest to break up, and would exist in only infinitesimal proportions inside the Sun

We have here, not a difficulty with the otherwise well-established theory of the source of stellar energy, but something much more interesting and important We are apparently led straight to the conclusion that the matter which now forms the Earth (or, at least, its accessible exterior) has never been buried deep inside the Sun, or any other star Moreover, the same can be said about the surface layers of the Sun itself, for its spectrum shows lines of lithium and beryllium, faint but identifiable without question, showing that here, too, these fragile atoms must be vastly more abundant—perhaps it would be better to say, less rare—than in the Sun's interior

"Never" is a very bold word to use in a scientific statement In its stricter sense, it is clearly not permissible, for it would mean that our statement was valid throughout an infinite past—which of course goes far beyond the limits of physical reasoning If, however, we interpret "never" to mean "not while the universe of stars has existed in its present general state," we can go far to justify its employment. Our reasoning is based on three things First comes the undeniable fact of the existence of deuterium, lithium, beryllium, and soon, on Earth. Second, we have the easily disintegrable character of their nuclei, confirmed by numerous quan-

titative experiments. The conclusion that the mean lives of nuclei so easily disintegrated would be very short under the conditions which prevail in the Sun's interior appears to be very well founded The third pillar of the argument is the conviction that no process exists by which these light nuclei could be built up at such a rate, inside the Sun, that they might exist there in considerable abundance, despite their rapid decay. This proposition involves the familiar difficulty of proving a negative, and is, at the moment, less conclusively based than the other two But the number of ways in which these light nuclei could be built up out of lighter ones is strictly limited, and they have all been very carefully considered by Bethe with negative conclusions That they could be formed by some sort of fission of heavier nuclei appears to be exceedingly improbable, for their available "packing" energy (per unit of mass) is high, while that of the heavy nuclei is low—so that such a process would have to be fed heavily with energy to keep it in operation

We must inquire whether a mass of very hot matter inside a star, containing very little of these light nuclei, might not reconstruct them out of the hydrogen present within it, if it were removed and allowed to cool But this would demand that, at some intermediate temperature and pressure, the atom-building processes greatly outran those of disintegration — which raises the difficulties just mentioned, in an aggravated form

Unless—or until—some way out of this *impasse* can be found, we appear to be shut up to the conclusion that the presence of these light elements on Earth and in the Sun's atmosphere is a survival from some primitive state of the universe, perhaps antedating the existence of the stars. We must conclude, also, that there has been little or no mixing between the Sun's surface layers and its deep interior Our present knowledge of stellar constitution does not forbid belief in this, though it by no means demands it.

Accepting this, there are various possibilities regarding the origin of the Earth (and presumably of the other planets).

1. The Earth may have been formed from the outer layers of the Sun (or of a companion star, as Lyttleton suggests), which retained, or retained in part at least, its original chemical composition.

2 The Earth may have been formed from the Sun or some other star at an early stage in the star's history, when its interior was cool and the light elements had not been broken up

These suggestions have recently been made by Professor Bethe We merely add

3 The Earth, planets, and Sun may have been formed at some early epoch out of similar material, leaving the light atoms to be exhausted in the Sun's interior, but not elsewhere

Bethe comments that, although there might be very little intermixture of the superficial and deeper material in an isolated and quiescent star, this "seems not very likely at the time of a catastrophe such as the formation of the planetary system" The question whether the brief but intense heating of the filament of matter swept off by a grazing collision of two stars would lead to the complete disintegration of light nuclei would deserve careful study, were it not that Spitzer's work has made it very doubtful whether such a filament could condense into planets

THIS difficulty applies with equal force to the assumption of an encounter with the Sun in a primitive low-temperature state The additional objection that the Sun probably remained in such a state for a relatively short time, and that it is correspondingly improbable that it should have met an encounter in this interval, is less disturbing — for it is well known among mathematicians and philosophers that there is great danger of fallacy in attempting to reason about the *a priori* probability of a single event The assumption of a common and substantially simultaneous origin for the Sun and planets out of pre-existing material fits in well with the theory of the expanding universe, in Lemaître's form If, during the initial stages of the expansion, all existing matter was crowded into a volume very, very much smaller than it occupies at present, then—as Bethe says—"such a freak event as the formation of the planetary system could have occurred more easily"

How it might have happened, no one yet dares to discuss in detail but the immense turbulence which would attend the early stages of Lemaître's process offers possibilities which could hardly be met with elsewhere

But how did the more fragile atoms get there, anyhow? This question, which will not down in our minds, takes us to the boundary of the speculative—but not farther than we may properly follow it for a few moments

The theory of nuclear changes inside the stars, in its present state, accounts for the production of atoms of only one kind—the inert and uninteresting helium Whether hydrogen is consumed, by Bethe's cyclic and catalytic process, or lithium, beryllium, and boron by what appear to be one-way, irreversible reactions, helium is the end-product The light atoms, except helium, are consumed, and, despite a very careful search of the possibilities by Bethe, no way of building up atoms heavier than oxygen, or perhaps neon, has been found Hence we must accept as a part of the initial data of the problem of stellar energy the presence not only of the light atoms, but of the heavy ones, which form considerably more than half of the mass of most of the stars

Most of these, so far as we know, might have existed indefinitely in their present proportions, since, even inside the stars, their nuclei will not undergo sufficient violence to produce changes in them. But the heaviest atoms of all—thorium and the two isotopes of uranium—are radioactive, and decaying steadily There seems to be no chance at all of building them up under the conditions which prevail inside the stars If they ever had still heavier parent atoms, these must have had shorter lives than their own (since they do not survive) For their formation, we must look to some state much more radically removed from the present than exists anywhere inside the Sun

It has been suggested informally by Bethe and others that these atoms might have been built up along with all the intermediate ones in an enormous mass of matter at a very high temperature (something like a billion degrees) and a fairly high density Whether something of this sort happened at the very beginning of the expansion of the universe, we do not know, but, apparently, if we wish to make sense of what we do know, we must carry our speculations as far back as this. It would not be easy to go farther

Dumps a Car a Minute

Engineers Construct World's Greatest Scientific and Speedy Coal Car Dumper

L. T. HENDERSON

PROVIDING car-to-ship coal handling equipment unsurpassed anywhere in the world for volume and speed, and increasing its already extensive facilities on Lake Erie at Sandusky, Ohio, the Pennsylvania Railroad recently placed in operation a new machine on a mile-long dock, with yards and supporting features, costing altogether $4,250,000.

With its other two dumping machines working at near capacity season after season, the Pennsylvania Railroad decided to build a third machine, the equal of which never before had been constructed The new dumper empties cars at the rate of 60 an hour and, together with the railroad's two older machines, makes Sandusky one of the greatest centers on the Great Lakes for the transfer of coal from railroad cars to vessels All three machines are of the lift-and-turnover type, the new dumper being electrically operated, while the older two operate by steam

In addition to its important new facilities on land, the railroad constructed a new channel in Sandusky Bay whereby the vessels serving this port could be handled to and from the railroad's coal-dumping equipment with a minimum amount of maneuvering The Sandusky coal-handling docks, conveniently situated as they are, provide an outstanding outlet for coal moved by rail from the southern coal fields through the Columbus, Cincinnati, and Louisville gateways

The docks and extensive supporting yard facilities are situated in the western part of Sandusky and the distance from the receiving yard on the south, through the classification and storage yards, to the outshore end of the newest of the three docks on Sandusky Bay is nearly five miles. The yards have a total capacity of 7800 cars

The latest developments in car-dumper design have been incorporated in the new No 3 machine, with numerous automatic features for controlling and correlating the various operations necessary for swift, efficient, and careful handling of coal from the yards to the ships The powerful machine lifts with ease the largest coal car—fully loaded—dumps the contents into the ship's hold, and returns the car to its original position, all in less than a minute

New mile-long dock and giant car-dumping machine are at left. Yards are below foreground

Loaded cars for the dumper are moved from the loaded car yard to the "ready" point at the foot of the inclined approach track of the machine by electric pusher locomotives Four of these powerful electric pushers are in use in the dock yard, operating on narrow gage tracks alongside the yard tracks. As each loaded car is placed at the "ready" point, its wheels are engaged by a spring-type, constant pressure, car retarder which prevents it from moving until a unique conveyor, or barney (dock employes call it the "pig") contacts it from a pit beneath the loaded car and pushes it forward up the 15 percent incline and onto the elevating cradle of the dumping machine The cradle is equipped with a pneumatic car retarder which stops the car in the desired place before it is elevated for dumping

AS the car rises, it is automatically moved to the dumping side of the cradle on a movable platform, and heavy steel clamps press against the top of the car, holding it securely as it is tilted to dump its load of coal onto the machine's pan

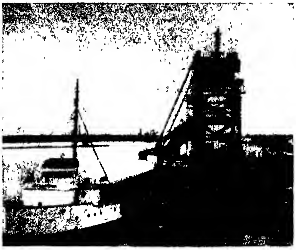
As the coal is transferred from the car onto the pan, an automatic, rubber-faced, coal flow retarder of the movable baffle type controls the flow of coal by backing gently before its load, easing the coal into a telescopic chute for placing in the boat, which is tied up beneath the chute The combination gate and trimmer at the lower end of the telescopic chute are controlled so expertly that the coal is practically laid in the hold of the vessel This careful handling prevents dropping or bouncing, and the coal reaches the hold in as good condition as it was in the car The machine has a high-

The "pig" (or barney), pulled by a cable hoist, pushing car up into No. 3 machine

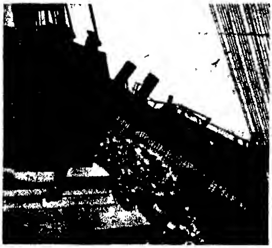
pressure water line to dislodge any coal adhering to the bottom or sides of the car

Another feature of the dumping operation is the automatically - controlled sprinkling equipment mounted on the coal flow retarder, which moistens the coal to the exact degree specified by the coal shipper or receiver.

Immediately after the car has been emptied and returned to its original position on the cradle, it is pushed off by the next loaded car and descends a 7 percent grade leading to



The kick-back trestle of the new dumper, and, beyond, the loaded-car and empty-car yards



Moving from car, left, to pan, the coal is sprayed to regulate moisture content

the kick-back trestle, which reverses the movement of the car and sends it, by means of a spring switch, onto the lead to the empty car yard However, before entering the empty yard, which is on a 0 45 percent descending grade, the car passes through a pneumatically-controlled car retarder, which regulates its speed.

Three operators control all movements of the car One is in a cabin on the approach side of the tower of the machine at a level 12 feet above the cradle This operator controls the barney, or "pig," and the car retarder on the cradle, and also starts the cradle in its lifting operation. Another operator, in a cabin at a point above the pan, controls the cradle hoist, the pan and the pan girder, the sprinkler system, and the flow retarder The third operator, stationed in a cabin at the outer end of the pan manipulates the pan, the chute, and the trimmer gates, and also the controls for raising and lowering the pan girder The operators' cabins are connected with each other and with the dispatcher's and foreman's offices by telephone, microphone, and loudspeaker equipment

The barney moves up the incline with a loaded car at a maximum speed of 11 miles an hour and returns to the pit at a maximum speed of 17 miles an hour, making the round trip in 55 seconds. The cradle's complete dumping cycle is 48 seconds

Electrical power for the dumper is provided by a power company in the form of three-phase, 60-cycle current at 23,000 volts, which is reduced to 2300 volts by a substation on the premises

The new dumping machine is situated 585 feet from the outshore end of an earth-fill dock which is 4500 feet long and 600 feet wide and represents, in itself, one of the greatest construction projects undertaken in the Middle West in recent years Along the westerly side of the dock, the fill material is retained behind a stone revetment, while on the easterly side, which is the loading side, a steel sheet-pile bulkhead of cellular construction was built and surmounted by a reinforced concrete dock wall A total of 9¼ million pounds of steel sheeting went into the construction of the rock-filled cells of the dock wall and more than 2¼ million pounds of steel piling support the concrete cap which tops the cells and forms the floor of the pier The piling was driven to solid rock. The dock wall and foundation for the car dumping machine required 14,000 cubic yards of concrete

A new ship channel was dredged, requiring the removal, by the hydraulic process, of 2½ million cubic yards of soil Nearly two-thirds of the soil removed was used to fill in the area between the dock wall on the east and the dike, approximately 600 feet to the west, and on this made land are the new dumping machine, yards, and other supporting facilities.

The new dock yard has a capacity of 550 cars—350 in the loaded yard and 200 in the empty yard—and was planned to provide for future development even to the installation of another car dumper, complete with supporting car yards

The channel work included a new 400-foot dock channel, 22 feet deep, along the east side of the dock, a new approach channel 300 feet wide, 22 feet deep and 8000 feet long, parallel with the original ship channel, and 3000 feet bayward therefrom, connecting with the entrance channel to Sandusky Bay, near Cedar Point Thus was formed a loop which permits vessels to enter the slip along the new dock via the original channel and to leave by means of the new channel Ships loading at the No 1 and No 2 coal dumping machines also use the new channels, thereby expediting the maneuvering of the boats

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NITRIDED STAINLESS

To the corrosion resistance and strength of stainless steel has now been added surface abrasion resistance by the process of nitriding. The new nitrided stainless steel is being adapted to steam valves, in textile machines, for parts in oil well pumps, and the like.

CANTONMENTS

Extensive Engineering Necessary In Building Camps

THE country is launched upon one of the largest single engineering jobs it has undertaken for many a day It will build at high speed

numerous camps for our National Guard and conscripted armies

We are inclined to overlook the fact that there is more to a Conscription Law than mere passage by Congress and registration and drafting of men World War camps and other sites will be cleared of stands of scrub timber and of the evidences of cultivation Speedy work must then be done with excavators, tractors, and trucks, in preparing foundations, paved streets, street lighting, and all the numerous facilities required Where semi-permanent barracks are being constructed, they will more often be two stories and (World War Veterans take note!) will be equipped with heat, shower, and toilet equipment

Cost of temporary barracks at army posts is expected to run to more that $350,000,000 Many hundred millions of board-feet of lumber will be required as well as proportionate quantities of cement, bricks, electric wiring, and the like It is believed that World War construction mistakes will be avoided

BALL TANK

Sphere, For Water, Tops Enclosed Tower

THE photograph on this page does not show the beginning of construction for a World's Fair, it is one of 10 water tanks of the balanced-ball-on-pin design that have been built by Chicago Bridge & Iron Company This particular tank was built for the town of Longmont, Colorado, and has a capacity of 100,000 gallons of water Height is 60 feet to the bottom of the sphere Others of the type have been built with greater water capacity and considerably higher than this one

. . . 100,000 gallons of water

ELECTRIC HAMMER

Development Presented Special Problems

ONE of the things that has made American industry great is the fact that our engineers like nothing better than to tackle and lick a tough problem, whether it be in design, production methods, or materials In the manufacture of portable tools, the electric hammer has been one of the most difficult to make.

Twenty years ago the Wodack Electric Tool Corporation set itself the task of manufacturing an electric hammer for drilling concrete, and has been at it ever since, says *Nickel Steel Topics* A simple and practically trouble-free hammer mechanism has been evolved, but due to the terrific strain on the hammer parts in striking 2400 blows a minute, the greatest problem to solve was in finding a sufficiently strong and shock-resistant alloy steel and heat treatment that would give a reasonably long life to the working parts A nickel alloy steel supplied the final solution of the problem

Representative models of the electric hammer described here. The hammer-holding chuck can be seen through the case hole

The outstanding feature in the design of the Wodack "Do-All" electric hammer is that by loosening a cap screw and opening the chuck, the hammer member is removed and the power member can be used as an electric drill and grinder The hammer drills holes in concrete and masonry as large as 1⅜ inches diameter and the drill has a rating of ⅜ of an inch in metal The "Do-All" finds its greatest use in the building construction field but it is also extensively used as an industrial maintenance and installation tool for drilling holes for expansion bolts and screw anchors

COUNTY MAPS

Show All Rural Structures In Most U. S. Counties

A NEW kind of county map, showing all highways and all structures in rural areas, will soon be available through state highway departments Drafting work on sheets covering 2741 counties — or approximately 90 percent of the counties in the United States — has been completed. According to the Public Roads Administration, such maps will soon be completed for all counties in every state and many of the state highway departments already have them available for general use

Their details range from the railroads, highways, roads, and bridges to the separate dwellings, farm units, and stores and industrial plants in the rural areas Distinction is made between occupied and vacant structures Streams actually navigable are shown Also shown are such details as schools, hospitals, churches, cemeteries, camps or lodges, oil and gas wells, mines and quarries, power plants, radio stations, and air fields

These maps are being used by business organizations and government agencies in addition to their use in highway planning In 29 states, they were used by the Census Bureau for laying out the field work of the enumerators employed in the 1940 census and in fixing boundary limits around the settled areas of un-incorporated urban communities of 1000 or more population.

Life's Debt to Death

Nature's Attempts to Circumvent Death in Her Species May Suggest Conscious Purpose

EDWIN R. BOGUSCH

THE moment an organism begins to live it starts its relentless struggle against the forces of death. Every phase of its living existence is an expression of its effort to outwit nature, for in the plant and animal world there is no divine right to life That belief exists only in the imagination of man

The survival of the individual is unimportant in this battle for existence The perpetuation of the race supersedes in importance the life of any single member of that race Under the stimulus of approaching death living beings hasten reproduction to levels of activity abnormal to the species

When that plant curiosity known as the agave or century plant has completed its normal span of life it produces root-sprouts at its base even before the giant flower stalk saps the last of the vital energy of the plant in its culminating triumph of reproduction But, should something injure a normal, vigorous century plant still young and far from maturity, the plant responds with amazing concentration of energies to produce root-sprouts and provide for another generation The activities of gnawing animals or fungi upon the roots stimulate the adjacent region to the growth of buds and new plants

Some of our common trees, like the black locust, are so prolific in this type of response to root injury that even any interference with the normal flow of the vital water through the roots will result in root-sprouts Just the shrinking of dry soil about the roots, that may strain and tear the tissues, stimulates this development. Botanists call this wound-stimulus. The result is an apparent effort of the plant to perpetuate the species even before the certainty of approaching death becomes established

Similarly, when yeast plants fermenting in the bottom of a brewer's vat are subjected to higher than normal temperatures, the yeasts stop growth and undergo an entirely different physiological process. The cell contents separate into an even number of rounded bodies, each with an individual membrane Later, when the mother cell breaks down and disintegrates, the newly formed spores are set free Each is now a resistant individual capable of withstanding sustained high temperatures, extremes of desiccation, and even freezing; each can under optimum conditions resume life again where the parent cell was forced to stop

AMONG the lesser forms of plant life, such as the molds and other fungi, when food becomes scarce further growth diminishes and the plant body expends its remaining energies in the production of reproductive spores In stagnant ponds where green and blue-green algae abound, summer temperatures evaporate the water, concentrate the minerals, and stimulate rapid sporulation to guard the continuity of the species even though the parent must of necessity die.

Indeed, it is now believed that our animal and plant life has so abundantly survived because it adapted itself to seasonal conditions ahead of the time that those conditions were felt Where the migrating bird flees southward in autumn because it must live to carry on the species to nesting time, plants developed an annual seed habit That seed in which the tiny plant embryo nestles dormant and unaffected by winter owes its existence to the fact that the parent plant devoted all its energies to producing those seeds before frost, instead of storing an accumulation of food in its own roots for another season's growth

Conversely, certain species commonly believed to be of tropical origin, such as the banana and the canna, have nearly or entirely lost the seed habit in the warm tropical environment, where seasons have no extremes and where the need for a dormant, resistant propagule is no longer felt

So definite and close is the response of certain plants to factors associated with seasonal change that even the length of the day will have an immediate effect upon a particular generation Thus the poinsettia, which normally flowers at Christmas time may be made to produce its highly colored blossoms in mid-summer if the length of the day is artificially shortened by darkening the plant a part of each day Likewise, in the case of the Mammoth strain of tobacco

How the century plant doubly insures the perpetuation of its species

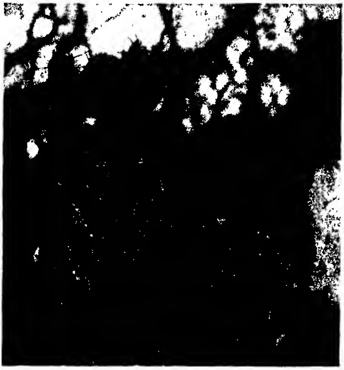
which in the latitude of Maryland devotes its entire development to leaves, the plant must be grown in greenhouses in winter during shorter days if it is to seed Or, if it is to seed profusely, it must be planted and grown in Florida, where the summer day is shorter than that of Maryland Shorter days herald the approach of winter, and tobacco is one of those plants which are adjusted to anticipate the change of seasons in this manner by the production of seed

Dry, hot winds of a Central Plains summer, icy arctic blasts of a late frost, inundation from an overflow—each in its own way exacts a toll from the life it affects, each brings death to the individual. Yet, none of these forces can work the extermination of the species, for, as death stalks, new life is prepared and laid to rest in the shroud of its dead parent to await another spring No wonder man, in his groping toward an understanding of the Universe, conceived of the immortality of the soul!

So, in this endless quest for life a feeble, bent broomweed blossoms with starry yellow flowers beside a burning hot roadside, the homely carrot of the garden rushes into bloom after a sudden late frost and dies with seed matured, instead of growing a healthy, tuberous root, a nearly drowned willow or aspen blooms once more as the slowly rising waters impounded behind a dam begin the tree's destruction.

Nor are plants the only victims of these natural tragedies, animal life responds to the extent of its ability The caterpillar enters its pupal stage in advance of its normal time following an injury, the viviparous fly releases its maggots when trapped or hurt, the hen stops laying and starts incubating her eggs ahead of time with the arrival of hot weather And this should not seem strange, for the human mother, without volition and through forces completely beyond her control, may enter labor and give premature birth to her child when fear, shock, or physical injury threatens her own life It is the unconscious response to danger threatening the survival of the species In one last valiant effort the body strains to thwart the grim reaper Though dying, the body, whether human, animal, or plant, sets into the world a new spark of life with which the continuity of the kind may be maintained.

Then there is the example of the bee, whose communal life has become classic Among the bees, with their perfect division of labor according to the individual's ability, the perpetuation of the kind is left entirely to the queen-mother. She weds with the drone, who, when his mission in life is done, is rewarded by death so that the food supply of the hive will not be needlessly expended He is either cast out to die of starvation or mercifully stung to death by the workers The queen-mother lays the eggs The workers—all of which are sterile females and the old maids of the insect world—attend to the young, do all the necessary work, but never reproduce their kind. Indeed, reproduction on their part would be totally impossible.



If an insect lays its eggs in a prickly pear, growth is started anew and the new pads fall off and take root

In spite of the seeming fixedness of the potentialities of each member of the bee colony, the species still holds a trump card in its battle with death. Should death destroy the queen-mother, the species must play this card in order to survive. If no other queen is at hand, the egg destined to be a worker is placed in another cell and nourished to become a queen-mother Should even this egg be unavailable, a sterile worker will in some mysterious manner become a fertile female, assume the role of the queen-mother, and carry on the continuity of its kind. The chain of life must remain unbroken in order to exist.

The strange and almost supernatural feature of this power to carry on reproduction is that it lies beyond the realm of voluntary control and almost beyond the powers of human comprehension Ants, whose colonial habits rival and sometimes exceed those of the bee likewise can under conditions threatening the extermination of the species produce a queen-mother to continue the creation of progeny Those ant-like wood-digesting insects known as termites are likewise so endowed And the result is an enormous potentiality to live and a wonderful ability to beat death's effort to eliminate a species through the destruction of the individuals

More commonplace are the unique relationships existing between organisms of different origin. The end-results of their mutual activities continue to stimulate the perpetuation of their own kind Everyone has seen the warty, knot-like growths on the twigs and leaves of such trees as oak, hackberry, elm, and others These galls are the consequence of the stimulus provided by an insect which stings the affected plant part to deposit its own eggs The plant, to defeat self-destruction, develops corky tissues which in turn provide shelter for the larvae of the insect.

Among that large group of cacti known variously as prickly pear nopal, or—in some of its forms—as cane cactus, the sting of an egg-depositing insect upon the seed-bearing part of the flower produces startling development. The particular insect associated with this cactus stings the ovary in which the seeds are to mature and deposits its eggs within the plant ovary. The

In bryophyllum, if the roots rot, each leaf produces new plants at the margin. These later fall off and take root. Thus the species lives on

cactus, whose own progeny are now endangered, is stimulated to renewed growth and promptly produces a new flower from the summit or the side of the old ovary Should an insect again sting the new seed container, the cactus responds again in a similar manner

The final result may be a chain of ovaries attached to each other, each representing the plant's involuntary effort to perpetuate its kind against the forces threatening its death Dr Rose, who before his death stood as the world's foremost authority on cacti, reported cactus plants in the southwestern deserts with chains of such proliferating ovaries several feet in length

Thus each organism, in its own way, works against death and, because of that constant threat, provides in the most ingenious of ways to insure life for its children The pathetic effort of an apricot tree whose life is doomed through frost injury to flower and fruit out of season in one valiant last effort to make seed is a drama in survival. The early maturity of the fruit of the virus-sick peach tree is a similar effort to beat death to the punch.

Likewise, the peculiar response of the so-called air-plant, *Bryophyllum*, whose leaves produce miniature plants upon its margin, is peculiarly adapted to survival. In its native tropics, when high humidity induces destructive rot to ruin the roots and stem of the plant and thus doom it to death, each leaf creates its share of small plants. These later fall to earth when soil conditions are again more favorable for growth

Man, through his powers of reason and observation, has come to recognize how he may develop these peculiarities of plants and animals to his own ends. He has discovered that certain chemical substances known as hormones are really powerful poisons which in extreme dilutions stimulate dormant plant cells to develop roots where none would normally appear. So now he places cuttings of plants in hormone solutions and in an amazingly short time grows roots on even very obstreperous species.

Or man plays with the delicate germ plasm of certain animals and fungi under the odd and dangerous light of the X-ray and finds that evolution has been enormously hastened and even diverted into peculiar new channels What will he get? A new species of interesting value? That depends upon the human interpretation and definition of a species Scientific logic states that it is still the same old species, fighting a form of death by developing a mass of individuals, among which may be some more able than the rest to survive

Thus all life owes a debt to death, for death stimulates powers within the living being to fight more effectively the forces which threaten its destruction

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The Auto Show Moves In

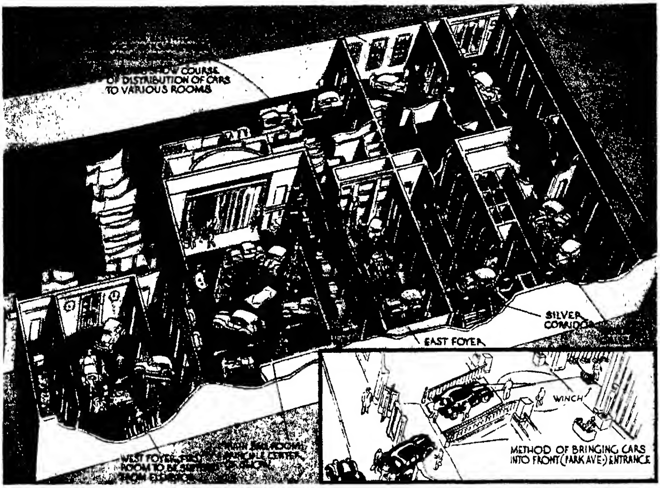
Mechanics of Handling the Cars and Other Displays in the Ballrooms of a Huge Hotel

H. T. RUTLEDGE

Surging crowds surround the gleaming 1941 model motor cars in the main ballroom In five adjoining salons are more cars, other mechanical displays of the automobile manufacturer's skill, more crowds Yet only a relatively few hours before the first spectator looked upon this exhibit, these same rooms were devoted to the routine affairs of modern metropolitan hotel activity. So perfect is the setting for the motorcar show, however, that one might be almost willing to believe that the space so occupied was originally designed for just that purpose. And so it was, in the case of the Waldorf-Astoria Hotel in New York City where, a few days ago, was presented the annual General Motors display of their new models

When the hotel was under construction, some 10 years ago, representatives of the motor-car manufacturer gave whole-hearted co-operation to the architects and builders Even before the hotel was started, it had been decided that General Motors would hold its own annual display in the Waldorf-Astoria, in addition to participation in the Grand Central Palace Show. Knowing full well the headaches that accompany the presentation of an automobile display in buildings not designed for the purpose, officials of the manufacturing company were anxious to forestall future trouble

As a result of this foresight, it is not only possible to make the best use of the available space for displaying cars, but also to bring in



Preparing for the auto show at the Waldorf. ***Inset.*** **How lobby display cars are brought in**

the cars and other equipment with a minimum of difficulty and a maximum of speed Surrounding the Grand Ballroom at the Waldorf are five smaller salons—suitable for individual displays by General Motors car divisions. A template layout of the ballroom floor is made for each annual show, and the number of cars to go in each salon is decided Of course, all of the car divisions want to have mechanized exhibits such as cut-away chassis and transmission displays in addition to the show cars, so it is necessary to subtract car space to make way for these animated attention-getters However, the choice of display material is left, insofar as possible, to the individual car divisions

Information on what is to be displayed must be available well in advance of show dates, because preparations must be made to provide adequate electrical connections for each exhibit Every car on the floor has special interior lighting, some of the revolving chassis require 220 volt current, some displays use A C.; others D C., and so on The practice has been established to furnish all of this essential information to the hotel engineers well in advance of the show so that when the show-date arrives the electrical connections are all in place and ready for use

There is a very definite limit to the time alloted for the actual set-up of the show. A special invitation preview is to be held at 4 o'clock on the afternoon of the day before the Auto Show opens to the public As a margin of safety, the deadline for having the show ship-shape is set for 12 noon

By advance arrangement, the three small ballrooms nearest the freight elevator are cleared for action 56 hours before the deadline Dozens of crates and boxes of all shapes and sizes, packed with panels, sections of wall, canopies, decorative fabrics, and numberless articles of ornamental and utilitarian nature are hurried into these rooms and unpacked Time and space must be found to dispose of all of the crates and boxes, to say nothing of the task of putting together the many sections which, when assembled, make up the elaborate decorations.

Swarms of workmen, most of them old hands at the game, hustle the bulky panels and decorative pieces into a semblance of order so that the moment the Grand Ballroom is declared available the pieces can be fitted into the positions for which they were built The entire ballroom floor is available for the decorators just 32 hours before deadline Then the transformation begins

Special equipment to facilitate the job has been provided by the Waldorf engineers. One unique tool is a miniature derrick which is used to hoist canopies of substantial size and weight into position over main entrances Another is a tall, scaffold-like dolly for setting up huge panels which border the main ballroom

Each piece of decorative panelling, when designed, has to be divided into pieces small enough to meet certain physical limitations, such as the length of the freight elevator, the sharp turns in the corridors, low doorways, and so on They must be lashed, not nailed or screwed into position. No damage must be done to the walls or pillars of the ballroom.

Twelve hours before the deadline, the first cars and displays are brought up on the huge elevator. It would seem that the job should be simple—just put the cars on the

elevator and push them into place on the ballroom floor, but it is not quite that easy. There are six different makes of General Motors cars, in addition to displays by Frigidaire, Fisher Body, Research Laboratories, Delco Appliance, GMAC, GEIC, Customer Research, Diesel Engine, and others Some require a lot of time to set up, some are practically ready for the show the moment they are in place, some are to be centered in rooms through which other cars and exhibits must pass in order to reach their proper position Here is a job that calls for organization.

When Auto Show cars are shipped to New York, they are directed to the storage places of the various divisions which are in somewhat scattered locations around Manhattan Cars addressed to the big show at the Grand Central Palace must not be confused with those consigned to the Waldorf show The Waldorf cars, by direction of a GM Central Office co-ordinator, are each assigned a number A large tag bearing the number is placed in plain view on the radiator grille or bumper

At the hotel, the only route from the freight elevator to the Grand Ballroom that can be maneuvered by long-wheelbase cars is a roundabout passage through four of the parlors in which cars are to be displayed, a distance of between 400 and 500 feet This means that car #1 must be the car consigned to the farthermost point from the elevator so that it can find free passage through the rooms without interference from other cars or displays being placed in position Each succeeding car fills in the most distant spaces from the elevator until the last unit occupies a spot just a short distance from the elevator

None of the cars may be driven —they must be trucked to the hotel It is obvious that the truckers must be on their toes to get the low number cars delivered first Chevrolets, Pontiacs, Oldsmobiles, Buicks, LaSalles, Cadillacs—all must be picked up at different storerooms and brought to the Waldorf so that no time is wasted in getting them on the elevator in proper numerical order in relation to the numbered floor plan Also, large exhibits, such as chassis and cut-away motors, must be moved in simultaneously, so that their entrance dove-tails into the car movement at just the right time.

Then, too, there is the fact that it takes longer to set up a cut-away chassis than it does to place a car in position Squarely in the center of the Buick salon may be the spot selected for such a chassis, and a start cannot be made on putting it up until every single car which is consigned to the rooms beyond has passed through. With this problem in mind, a "time-in and set-up schedule" is prepared If it is found that six hours will be required to get the chassis functioning, particular care is taken to be sure that all of the cars scheduled to be displayed in rooms beyond the Buick salon are in place before 6 A. M., allowing a full six hours for the Buick men to finish their task by deadline.

Even getting the cars properly located involves more than meets the eye. Ramps are laid to make it possible for the cars to climb steps Rubber-tired jacks are used to jockey the units into exact position, with space for traffic carefully calculated Gas tanks are drained, batteries disconnected, spring shackles are wiped free of grease, oil is drained, and interior illumination is installed There seems to be no end to the details

Time, time, time . . . the deadline has come and that four-hour margin of safety was a good thing There is still some work to be done on exhibit set-up and the cleaning has necessarily lagged behind while work is still going on. Finally, with one hour to spare, the last car is polished and the show is ready There have been times, however, when, twenty minutes before 4 o'clock, the ballroom looked hopelessly in disorder, but somehow or other the work got done, just in the nick of time

Over and above all of the ballroom activity is still another job which must be handled in the wee hours of the morning of show day It has been the custom to display a Cadillac car in the main lobby of the hotel, at the head of the steps near the Park Avenue entrance. There is only one way to get it in, by removing a door and frame, pushing the car over the sidewalk and through the door, and then getting it up the full flight of steps. It's a tight squeeze through the door, and another tight squeeze to get the lengthy unit around the corner so that it is headed straight up the stairway. A capstan is anchored to two huge pillars across the foyer opposite the head of the stairs, which pulls the car neatly up the steps on planks. It has even been necessary, when Cadillac planned to build a wider car than production models of previous years, to build a crate, weeks before the show, corresponding exactly with the outside dimensions of the car, and move the crate into the lobby as a sure check that the car would fit

The Waldorf show has become a tradition in General Motors It is the high point of announcement time, and assumes great importance as a stimulus in giving the new models a good start During the annual motor show week, Detroit literally moves to New York and takes over the town, and as far as that goes, the entire nation Automobiles are the topic of conversation everywhere, and the already automobile - conscious American public digests a whole new chapter of the History of Automobile Progress

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BATTERY

Storage Type

For Flashlights

The user of a flashlight is faced not only with the expense of frequent renewals but also with the occasional necessity for using batteries that are weak and give a poor light. The Ideal Commutator Dresser Company has wiped away both these disadvantages with one stroke in the development of a storage battery for flashlights.

This new battery takes the place of two 1½-inch, size D dry cells Its upper section is made of DuPont's Lucite, as that material is impervious to battery acid. This transparent material enables the user to see whether distilled water may be needed at any time, this water being added by unscrewing the top cap and dropping the water in with a medicine dropper

LONG-LIVED FUNGUS

Starvation and other unfavorable conditions seem to make no difference in the life of at least one fungus—that which causes the stem rot of rice The Department of Agriculture says, therefore, that it is not practicable to try to control this plant disease by rotation of crops

A six-year test was carried out by the Department's experts by screening infested soil to prevent

Above The Solovox, a musical supplement to the piano, has a six-octave range and an indefinite variety of tone colors. *Below:* Solovox keyboard

new infestation After the six years elapsed, they found some of the sclerotia still in condition to renew activity and cause the disease whenever there was rice tissue on which the fungus could grow

SOLOVOX

Fascinating Sound Effects With the Piano

A NEW electronic musical instrument—the Solovox, designed to be played with the piano—was introduced recently by Dr Frank Black, music director of NBC on the Cities Service program Both musicians and piano manufacturers believe that it will stimulate new interest in the tradition of music in the home and will have a stimulating effect on the piano industry

According to Dr Fritz Reiner, "Laurens Hammond's new instrument, the Solovox, is not only an outstanding technical contribution to the number of electrical instruments but also a musical one Its endless possibilities for creating new and fascinating sound effects in combination with the piano, will kindle the imagination of every pianist In fact, the Solovox may revitalize the present style of writing for the piano"

The Solovox is Mr Hammond's third contribution to electronic music, its predecessors being the electric pipeless organ which was first introduced in 1935 and the Novachord, which made its first appearance in 1939 Like these instruments, the Solovox is entirely electrical in operation, but unlike them it has been designed not as a complete instrument in itself but rather as an adjunct to the piano and to be played simultaneously with it The Solovox consists of a keyboard with 36 keys, about one half the size of piano keys, which is attached by thumb-screws just below the piano keyboard, and a slim tone cabinet containing the necessary electrical equipment which is mounted underneath a grand piano or set alongside an upright piano The Solovox keyboard is attached to the right end of the piano so that the player can span both the Solovox and piano keyboards with his right hand. Thus he can augment the brilliant percussive tones of the piano with a tremendous variety of tone colors, some of which suggest the shrill quality of the piccolo, others of which suggest the singing tones of the violin and the piercing tones of the brasses. The Solovox is easy to play and can be picked up by even the self-made pianist in a few hours The Solovox is an instrument whose market possibilities are, numerically speaking, 1000 times greater that the organ due to its comparatively inexpensive price under $200

MULTITUDINOUS

Bacteria In Ocean Use More Oxygen Than Fish

OXYGEN in the ocean is probably used up more rapidly by bacteria and other micro-organisms than it is by all the fish and other visible animals ranging from tiny shrimp to giant octopuses, suggests Dr Claude E. ZoBell of the Scripps Institution of Oceanography at La-Jolla, California.

Bacteria swarm in the depths in simply incredible numbers, Dr. ZoBell states A quart of ocean water may contain anywhere from 100,000 to 10,000,000 bacteria, consuming oxygen at the rate of .001 of a cubic centimeter to more than one cubic centimeter per quart per year. This looks rather insignificant, says *Science Service*, in reporting Dr ZoBell's discussion, but there are quite a number of quarts of water in the ocean, and the total becomes staggering.

Oxygen consumption becomes a

particularly acute problem at great depths, for the only way this life-gas can get down there is to diffuse slowly from the surface—with bacteria and other living things snatching greedily at it all the way down. This dearth of oxygen may be an important factor in the paucity of life in the great abysses.

GLARELESS

Student's Light Makes Use of Polaroid

POLAROID is now available for the first time in a popularly priced study lamp that promises to be the modern successor to the old-fashioned "gooseneck" lamp

Advantages of glare-free light are many. Black type may actually

disappear from a white printed page under certain glare conditions But even under the most severe glare condition, it was determined that the proper introduction of Polaroid sheeting in the light path dissipates the undesirable glare element and restores the print-to-paper contrast that is necessary for effortless seeing

FOREST GAME

Many Game Birds Thrive In Forests

APPROXIMATELY 66 percent of the food of all birds consists of insects A large number of song birds are the principal consumers of insects Many of these birds feed almost entirely upon this sort of food Game birds also take a great many insects, the young chicks more than the older birds. This is of particular importance from the viewpoint of sportsmen.

A recent study made at Massachusetts State College shows that the alder-bottom forest floor pro-

duces the greatest number of insects and spiders which game will eat. The second most productive source of large insects, suitable for game food, is the white-pine-hardwood forest type But the greatest total of insects, regardless of their usefulness as game food, was found on the forest floor of the hemlock-pine type

There are many kinds of game which thrive in the forest, and the forest is always justified, from a sportsman's viewpoint, not only as cover for wild life but because of the beneficial effect it has on watersheds, and consequently the favorable influence upon fish life

SCRATCHLESS

Synthetic Rubber Gasoline Nozzle

AUTOMOBILE owners who have had their cars scratched by the brass nozzles of filling station gasoline hoses will welcome adoption of a

Rubber protects the car finish

new nozzle made of Goodrich synthetic rubber This nozzle, shown in the accompanying illustration, is the first such nozzle to be listed by the Underwriters' Laboratories, Inc, and is the product of several years of research

NOT DAFFY

"Condition" Animals to Fear One-String Fences

A SINGLE string, hung between slender posts, may be enough to keep the cow of the future in her pasture if cows are psychologically conditioned. The conditioning would only mean punishing the animal with a mild electric shock

every time she went near the string Even a cow soon learns to stay away from all strings after that.

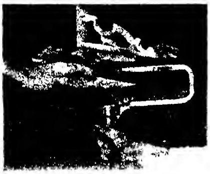
Psychology could thus save the farmer the enormous costs of iron fences and electric devices now used, Dr. A. I. Gates of Teachers College, Columbia University, recently told the Educational Section of the American Association for Applied Psychology. "Although a farmer neighbor of mine declared this was a daffy idea, it is good psychology," declared Dr Gates

—*Science Service*

JIG-SAW

Hand-Operated, Inexpensive, Fast Cutting

A NEW jig-saw, put on the market by Dremel Manufacturing Company, is a hand tool which uses less electricity than a 75-watt lamp



Vibrating jig-saw

bulb, runs at a speed of 7200 strokes per minute, will cut through ordinary plywood at the rate of a foot forward per minute, and cuts so smoothly that no sanding is required These details sum up the important features of the new Moto-Saw The device weighs only 17 ounces, operates on 110-120 volt alternating current, and is priced at less than five dollars

The illustration shows the ease with which this machine is handled Above the hand grip is the vibrating mechanism which holds one end of the saw blade The upper end of the blade is gripped at the end of a spring arm, mounted on a goose-neck frame.

ALWAYS BUSY?

Bees Take Life Easy When Food is Scarce

BY an ingenious device that relieves bees of their pollen loads while permitting free passage into and out of the hive, entomologists in California have compiled records that cast doubt on the familiar idea of the inveterate industry of these insects When a bee is "as busy as a bee" she is that way because abundant food supplies are available for harvest But when dearth occurs, she takes life easier and does not bring home much pollen, either for immediate use or to mix with honey for storage as bee bread

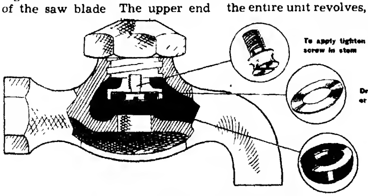
WEARLESS WASHER

A NEW snap-on washer eliminates leaky-faucet trouble Made of rubber composition, it is so made that it does not turn and wear itself out against the seat Furthermore, it is replaceable without a screw driver, as it simply snaps in place with the fingers

This inexpensive new washer comes with a special screw having a grooved head, and a thin brass washer The entire unit sells for ten cents retail, and replacement washers are but five cents

In installing this device, the standard washer screw is removed and the grooved-headed one inserted tightly Over this is first dropped the brass washer, then the rubber washer is snapped over the grooved head of the screw The opening in the rubber washer is recessed so that a ridge moves freely in the groove of the screw-head

When the faucet handle is turned, the entire unit revolves, but as soon



Wearless washer installed, and details of parts

as the rubber touches the seat it holds steady while there is slip between the thin brass washer and the rotating valve stem.

This ingenious new device is patented and is the product of No-Pans Washer Company.

WORLD CLOCK

Time Throughout World At a Glance

At both the Golden Gate International Exposition and The New York World's Fair, the International Business Machines Corporation exhibited first models of a unique clock which may find use in airline depots, in steamship offices, and in many other locations where there is need for, or curiosity about, the time in all parts of the world This clock, of comparatively large size, is to be mounted on the wall, and consists of a projected map of the world marked off vertically in hourly time divisions

The map itself is immovable, but a black band lettered for hourly divisions of the day moves across the top of the map Above this moving time strip is a spot in which minutes are indicated by numerals Reference to the accompanying illustration will best indicate the simple method of reading the time for any part of the world. It will be noted that the time band has moved to a point showing that New York, for example, is in the 2 00 P. M. range The 58 minutes indicated above the strip give the exact time in New York as 2 58 P M. To the right, England and a large part of Europe are in the 7·00 P. M range; hence the time in England is 7 58 P M.

Similarly, the time in any other range throughout the world may be instantly read by looking upward from the geographical point to the time indicated on the time band and the number of elapsed minutes shown above that. One other point to note is that lights behind the map itself follow the movement of the band at exactly 12:00, Noon, so that one gets a sense of the sun spreading over that portion of the earth at that particular time and shading into dawn at the left and twilight at the right.

This clock is a development of Miss Maud M Clough, and will be manufactured by International Business Machines Corporation.

BIBLICAL SCIENCE

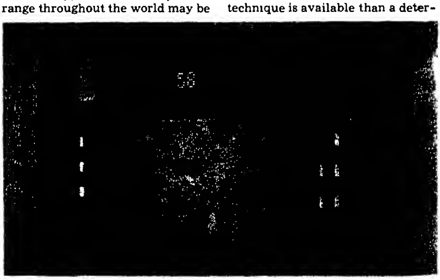
Jeremiah Made Scientific Observation

"Yea, the hind also calved in the field, and forsook it, because there was no grass

"And the wild asses did stand in the high places, they snuffed up the wind like dragons, their eyes did fail, because there was no grass" —Jeremiah 14. 5 and 6

Thus as long ago as biblical times the observation was made that when there is no grass on which animals may feed, one of the first and most characteristic symptoms is that of blindness Today we know that grass and all green growing plants contain a yellow pigment, carotene, the precursor of Vitamin A, which, when absent from the ration of all animals, produces as one of its most specific symptoms, xerophthalmia, or blindness, prevalent in humans as night-blindness.

And even today, when scientists wish to determine the minimum vitamin A requirements of farm and domestic animals, no better technique is available than a deter-



Time to the minute, in any part of the world

Checking field distribution of new type of television antenna

mination of that minimum amount of vitamin A value which is just necessary to prevent the onset of night blindness

Today the poultry- and cattleman can easily and quickly obtain a carotene assay of the feed he is to buy. Most feed manufacturers determine carotene as a routine practice in their laboratories and thus are able to protect themselves and their customers

TELEVISION ANTENNA

WITH experimental work in television transmission progressing steadily and new methods being adopted in the endeavor to increase efficiency and service area, the accompanying illustration takes on added interest. It shows a part of the conical television antenna recently erected at the General Electric Company, Helderberg Station W2XB near Schenectady.

In the photograph, one of the engineers of this station is exploring the field distribution of the antenna, using the well-known closed loop and radio frequency meter set-up.

FOR CLOSE WORK

Lens and Lamps For Precision Work

IF you have ever—and you probably have often—rigged up a strong light in connection with a large magnifying lens to do some close, fussy job, maybe you thought somebody ought to develop such a thing in finished, ideal form and manufacture it. This is what the Boyer - Campbell Company has done. It is a bracket with clamp to

Combination lens and lamp

attach to a chair or other support, case containing lens and light. The one shown is for doctors and hospitals; a similar one for shop use or precision jobs has been developed.

MECHANICAL MEMO

KEEPING memo sheets on a desk so they will always be handy yet not violate the executive's demand for neatness is a problem that has now

Turning the roller on this new memo case delivers one sheet

been solved by a new device—Rolodex, a "touch control" memo sheet case. Molded of Bakelite, it completely encloses over 200 sizeable sheets.

Near the front, on the top of the case, is a plastic roller. Underneath is the pack of loose memo sheets. When one is wanted, the fingers touch the top of the roller and, as they are drawn forward, the revolving roller brings out the desired sheet, right to your fingers.

SANITARY

Woven Plastic Seats Are Attractive, Clean

More and more, plastics are moving in on us—replacing products which, despite certain disadvantages, have been with us for generations. The latest move of this nature is into rapid transit vehicles to replace woven seat covers.

An accompanying illustration shows the seats in a New York subway car covered with Saran, a new woven plastic "fabric." Such seats, will be more sanitary and will not split and require replacement so often as do the present woven rattan splits.

END NUISANCE

Diathermy Apparatus Need Not Bother Radio

Transmissions from electro-medical apparatus have actually been received across the continent and even across oceans. When diathermy interference first began to be serious a number of years ago, the disturbances were first attributed to stations operated by persons under the jurisdiction of foreign governments. Then the signals were traced to diathermy machines operated in medical centers and offices of private physicians.

Diathermy apparatus affects radio reception because the machines are essentially radio transmitters. The radiation that causes interference is not essential for therapeutic purposes and steps are being taken to prevent such radiation.

SYNTHETIC WOMAN?

The Chemist Can Clothe Her Cap a Pie

We have long threatened to write someday an article on the synthetic woman—pardon us, the synthetic-clothed woman. Indeed, women are not only discovering that more and more of their garments and adornments are made of synthetics, but that these modern products of the

Woven plastic seat covers are sanitary, clean, durable

Celulose plastics add attractiveness to shoes, belt, bracelet

chemical laboratory are in some ways more attractive than would be the same articles made of natural products We present, as an example, an accompanying photograph from Monsanto Chemical Company showing new accessories for evening wear. Attractive enough on the printed page, these articles, which are woven and crocheted in intricate designs, give the effect of simulating jewels. Furthermore, the material of which they are made is tough, strong, and resistant to water, so that only a damp cloth is needed for cleaning

ANTI-AIRCRAFT

90-MM Gun, Now Standard, Is Effective Weapon

THE new 90-mm anti-aircraft gun is now a standard anti-aircraft weapon for the Coast Artillery Its rôle will be essentially that of the present standard 3-inch anti-aircraft gun, M2A2, which it will replace insofar as future procurement is concerned. However, all serviceable 3-inch anti-aircraft guns, including those now under manufacture, still are classed as standard and are to be continued in service. For the present, technical details of the new weapon will remain in a restricted category.

According to the *Coast Artillery Journal*, the gun will be known as the 90-mm anti-aircraft gun, M1, on 90-mm anti-aircraft mount, M1. Although its developed rate of fire probably will be slightly less than that of the 3-inch, its projectile is considerably heavier; hence in over-all effectiveness—number of effective fragments per unit of time—the 90-mm represents a considerable improvement over the standard 3-inch weapon The projectile of the new gun also has a shorter time of flight than that of the 3-inch for corresponding ranges and consequently a greater maximum useful range. In over-all weight and in tactical mobility the two weapons are approximately equal —*Army Ordnance*

PAPER DRILL

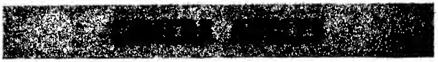
Punches Many Sheets At One Stroke

IN collating all manner of office records, it is frequently necessary for an employee to use an ordinary paper punch, go through the complicated business of measuring a few sheets at a time, and then punching by hand the holes that are to fit the material into a binder Even the larger, desk-type paper punches are often difficult to handle and do not punch accurately Christie-Lucas, Inc, has solved all these problems which can so often become major headaches, by developing a desk-type punch called the "Bull's Eye" paper drill

This machine is actually a drill, it takes up to a one-inch stack of paper at one time, and will drill up to seven predetermined registered

holes without removing the paper from the tray Despite this high efficiency, it is hand-operated and, therefore, may be moved to any location where it will find use for drilling manifests, sales bulletins, loose-leaf catalogs, and general correspondence.

Holes from ⅛-inch diameter up to and including 7/16 of an inch diameter can be drilled with this machine. Holes may be located from one-fourth of an inch to 1½ inches from the edge of a sheet. The leverage is six to one, and the manufacturer claims that any girl can operate it for hours with little fatigue.



Conducted by JACOB DESCHIN, A. R. P. S.

Telling Stories With Your Movie Camera

The motion picture camera is the story-teller par excellence in photography. The movie reel is the verbatim report of life's incidents, bringing to the screen as near an approximation of what we saw—and, in these days of amateur sound outfits, what we hear—as it is possible to achieve by means today available The chief characteristic of the movies is motion We take movies for that reason because it allows us to show a complete sequence of movements as when photographing a child at play or, by the stop-motion method, such subjects as flowering blossoms But movement of itself is not sufficient The movement must be significant, provide a living reproduction of something worth while, a subject in which movement is essential Therefore, unless movement contributes to the objective of making the subject almost literally "come to life" on the screen, you may just as well take that particular subject with your still camera

And that brings us to an inevitable comparison, odious though comparisons may be, between the results achieved with the still and the movie camera. Neither really competes with the other because each has its definite place The still camera intends to and does catch but one instantaneous phase of a subject. Sometimes it makes as many as perhaps a dozen *separate* impressions of the subject and calls the group of pictures a story-telling sequence or series. Within the limits of the still camera it aims to accomplish what the movie camera does, but *without motion*. However fine the result, such a sequence or series can be nothing more than a group of individual stills or photographs of the same subject taken at intervals. The story may be complete within the limitations of the medium, but can never really be complete unless motion is introduced, to merge one still shot with another by the natural movements of the subject in changing from one position to the succeeding one.

The objective in all movie-making is the projection screen. In shooting film, particularly if economy is the watchword, as it should be, let us try

Figure 2

Figure 1

Figure 3

Figure 4

to visualize at the same time what the results will be when projected Will our audience be bored because the scenes are too long or disappointed because the scenes are skimpy and therefore too brief to provide the impression or tell the story you thought you were shooting? Both faults should be avoided. In the first case, "splicing" in advance, that is, before shooting, is the best way, though some judgment and experience is admittedly required. The more splicing you do in avoiding insignificant and plus footage, the less you will have to do on the splicing block. On the other hand, if the scene is too brief it will be on and off the screen before your audience has had a chance to get any impression of it at all. Clipped scenes are probably the worst bugaboo of all for the still man who turns to movies for the first time. One of his first goals, therefore, though it is not too difficult to reach, is to battle and conquer the instinctive desire to short-change his scenes.

Concentration on significant movement is frequently accomplished by selecting an individual subject out of a group and shooting away at that until you have exhausted its possibilities. In Figure 1, we show a group of artist students painting a model on the beach at Provincetown. As a group, it was cinematically unworthy of more than brief notice—just long enough to show the group and allow the eye to get an impression of the general scene But a look around will usually discover some one subject that holds promise of interesting movement. This we found in Figures 2 and 3 The young lady in question had grace, movement, and now and then struck attitudes somewhat flavored with humor

The tiny fisherman made another good subject with the difficulties he was having keeping his fishing line untangled A scene like this would make an attractive bit in a longer reel of other doings on the same wharf

Sound Movies

Developments in the sound-movie equipment first described in Scientific American for December, 1939, have brought it to a high state of perfection and flexibility With available equipment you can make talking pictures at home, pictures as lifelike as those you see in the theater You can photograph your family or friends, singing, dancing, performing dramatic sketches You can take close-ups of dialogue The voices will

Above: **Bolex camera with Synchrosound drive.** ***Below.*** **Turntable unit, five-minute disks**

Fifth Annual Scientific American
AMATEUR PHOTOGRAPHY CONTEST

OVER $1200 IN PRIZES

IN this year's contest, prints may be entered in any or all of the three groups listed below, in accordance with the rules In addition to the seven major prizes and five honorable mentions, there will be three SPECIAL AWARDS that will be accorded to the three outstanding photographs among the 36 prize winners. *These special awards will be given in addition to the regular prizes that the pictures win*

36 PRIZES PLUS Three Special Awards

DIVISIONS IN WHICH PRINTS MAY BE ENTERED

Division 1 Human interest, including camera studies of people, animals, and so on Portraits will be grouped in this division

Division 2 Landscapes, including all scenic views, seascapes, and so on

Division 3 Action, including all types of photographs in which action is the predominating feature.

IN EACH OF THESE DIVISIONS THERE WILL BE AWARDED SEVEN MAJOR PRIZES AND FIVE HONORABLE MENTIONS WINNERS OF THESE PRIZES BECOME AUTOMATICALLY ELIGIBLE FOR THE THREE SPECIAL AWARDS.

RULES of the CONTEST

1 The groups will be judged independently on the basis of pictorial appeal and technical excellence The decision of the judges will be final In case of a tie for any prize, duplicate prizes will be awarded to the tying contestants

2 Prints must not be smaller than 5 by 7 or larger than 11 by 14 inches All prints must be mounted, otherwise they will be returned immediately

3 Photographs must be packed properly to protect them during transportation

4 Non-winning entries will be returned only if sufficient postage is included when the prints are submitted

5 Each entry must have the following data written on the back of the mount Name and address of contestant, type of camera, and film, enlarger, and paper used

6 Contestants may submit no more than two prints in each group, but may enter any or all groups In no case, however, will more than one award be given to any individual contestant

7 Prints must be in black and white. Color photographs are not eligible

8 Prize-winning photographs will become the property of Scientific American, to be used in any manner at the discretion of the publisher

9 Scientific American reserves the right to purchase, at regular rates, any non-winning entry

10 No entries will be considered from professional photographers

11 All entries in this contest must be in the hands of the judges by December 2, 1940 Results will be announced in our issue dated February, 1941

12 The contest is open to all residents of the Western Hemisphere who are not in the employ of Scientific American

13 In fairness to all contestants, failure to comply with any of the above rules will result in automatic disqualification

THE PRIZES

1st. Three $125 LONGINES, Coronation Model, Solid Gold, Men's Wrist Watches.

2nd. Three $85 LONGINES, Presentation Model, Solid Gold, Men's Wrist Watches.

3rd. Three FEDERAL No. 246 Photo Enlargers (List Price $49.50).

4th. Three FEDERAL No. 345 Photo Enlargers (List Price $42.50).

5th. Three PIERCE CHRONOGRAPH Men's Wrist Watches (List Price $19.75).

6th. Three BERMAN-MEYERS Flash Guns complete with case (List price $15).

7th. Three FINK-ROSELIEVE Vaporators (List price $12.50)

HONORABLE MENTION

1st. Three Fink-Roselieve "Hi-Spot" Hollywood type spotlights.

2nd. Three Mimosa Perkino developing tanks.

3rd. Three Raygram Wood-Chrome Tripods.

4th. Three Fink-Roselieve Audible Timers.

5th. Three Fink-Roselieve Satin-Chrome Range Finders.

THREE SPECIAL AWARDS!

Winning pictures in the three divisions will be grouped and judged further to determine which three of them shall be considered as the best in the entire contest To the contestants who entered these three photographs will be presented the following special awards

1st. One No. 715 Weston Exposure Meter (List price $24.)
2nd. One No. 650 Weston Exposure Meter (List price $19.95.)
3rd. One No. 850 Weston Exposure Meter (List price $15.50.)

THE JUDGES

McClelland Barclay, artist
Ivan Dmitri, artist and photographer
T J Maloney, editor of U. S. Camera
Robert Yarnall Richie, photographer

Address all Entries to

Photograph Contest Editor, Scientific American

24 West 40th Street New York, N. Y.

be perfectly synchronized with the lip motion.

You can add narrative comment, music and sound effects to your present library of silent films Your voice and music will match the action of each scene with split-second accuracy Talking pictures can be made on either 8mm or 16mm film, black and white or color. The film is run at

For sound movies: Camera drive, turntable, and projector units

silent speed, 16 frames per second, saving one third of the cost of sound-film productions

In addition to their low cost, disk recordings have several advantages over film recordings for home, educational, and experimental uses The sound reproduction from the disk recordings is equal to the best sound-on-film Each sound recording can be played back immediately after it is recorded for checking purposes The records can be edited to match the final edited film. With synchronized disk recordings you can add sound to colored pictures without printing The original reversal film may be used

These advances in home movie making are made possible by the Syncrosound System which enables you to combine home movies with home recordings Synchronization between the disk and film is assured by a fool-proof mechanical and electrical locking system

To make and project talking pictures, you will need, in addition to your camera and projector, a portable sound recorder and three Syncrosound units—one for the recorder, one for the camera, and the third for the projector. The turntable unit is equipped with a bracket and mounting post so that it can be mounted on any recorder, home phonograph, or record player by means of one screw The camera drive unit is designed so that the tripod screw and one bracket hold the camera and motor drive firmly together.

Syncrosound units are now available for Ampro projectors, Bell & Howell 8mm and 16mm cameras and projectors, Bolex cameras, Keystone 8mm camera and projector, and the Victor 16mm camera and projector. Units can be supplied for other makes on special order.

Use the Large Stops

WHEN making enlargements, it is generally preferable to use the larger stops. Some workers automatically stop all the way down as a matter of course, after having focused with the lens wide open. The only times it is really necessary to use the

smaller stops is when the film plane in a faulty enlarger is not quite parallel to that of the baseboard—in which case you should have something done about the matter anyway—and when projecting on a tilted easel as when correcting for distortion At the very small stops, there is the danger of picking up the grain of a ground-glass diffuser, causing scattered light to cut down the contrast of the print, and unsharp pictures due to vibration during the relatively long exposures necessary at the small stops.

When is a Candid Shot?

PROBABLY you won't believe it, but this is *not* a posed picture in the usual sense of the term, although it surely does look like one. The gentleman was intently studying the picture possibilities in a group of fishing boats, when we came along and made our picture This was a rather easy one because the subject was absorbed in thought.

"Camera Fan"

Lamp for Ultra-Speed

A STUNT of the laboratory has become the useful tool of the working photographer in Eastman Kodak Company's adaptation to general uses of the lamp employed for high-speed photography by Dr. Harold E. Edgerton and his associates of the Massachusetts Institute of Technology. The unit is known as the Kodatron Speedlamp and employs a gas-filled, electrically-operated flash tube, providing an effective flash speed of about 1/30,000 of a second. This speed has been found to be adequate to stop virtually any moving subject except a rifle bullet. Although the speed of the flash could be boosted to 1/1,000,000 of a second, light volume would be cut down correspondingly.

The single flash provides illumination equivalent to that of 40,000 50-watt tungsten lamps, sufficient to provide fully-timed negatives of an average subject 50 feet from the camera at a lens aperture of *f*/11. The

1/30,000th second speed is, of course, many times faster than the highest setting of any camera; about 800 times as swift as the wink of an eye, and about ten times as fast as is necessary to stop an athlete in action. The tube yields more than 5000 flashes, after which it is replaced with a new tube One flash can be made every 10 seconds, the charging time of the condenser.

"The Kodatron flash is accomplished," write the manufacturers, "by discharging a condenser through

Kodatron Speedlamp

a gas-filled tube. Ordinary 110-volt, 60-cycle current is led into the power unit of the lamp, where a specially-constructed transformer steps it up to 2000 volts. This current is then rectified and used to charge a condenser When the trip circuit is closed (manually, by a flash synchronizer, or by the photocell unit), the energy stored in the condenser is discharged through the tube in approximately 1/30,000 of a second, producing a flash of high photographic efficiency"

The flash lamp itself has a tubular frosted glass shell, fitting over a spiral glass tube which contains a mixture of krypton and xenon gases This is the flash element, the gas heating to incandescence when the condenser charge is released through it Centered in the coil of the gas tube is the modeling or focusing light so that the angle of lighting is the same for both flash and modeling light The modeling light is a V-filament projection type bulb of moderate wattage and long life

Why Retouch?

A BRIEF for retouching as a matter of prime necessity, if successful portraiture is the goal, was recently put forth by J. Ghislain Lootens, F.R.P.S.

"If you are interested in portraiture you are going to retouch or be disliked by your friends," writes Mr. Lootens, who is a widely known teacher of photography as well as one

of our ace pictorialists "Of course, if you're a professional you don't even expect to take portraits without some retouching—that is, if you intend to stay in business.

"Experience has taught that there is no system of lighting or type of film that will consistently give pleasing pictures of all sitters We, therefore, don't retouch for the fun of it—it's a prime necessity

"The average amateur buys a book or magazine illustrating the so-called secrets of lighting and faithfully measures the correct distance between his sitter and lights He even uses the same equipment as the maestro, but his own pictures are simply terrible Why? Unquestionably he has been trying to imitate a portrait that was beautifully retouched, but no mention was made of that fact

"My advice would be Study good portrait lighting, of course, but don't forget that retouching goes with it."

• • •

THE ROUND TABLE

Questions Answered for the Amateur Photographer

Q. **I have heard that one can spot glossy prints by using graphite dust. How is this graphite mixed?—H. M. M.**

A. The graphite is simply shaved off an ordinary lead pencil, the regular spotting brush moistened and a little of the graphite picked up on the end of the brush, which is first formed with the fingers to a point Slightly work the graphite into the point of the brush using a piece of paper as a palette and then apply to print a little at a time It is best to apply retouching dope to the area to be spotted A retouching pencil or spotting color on a brush may also be used.

Q. **Directors of photography for motion pictures carry the title A.S.C. Will you please tell me the meaning of the above letters?—H. H.**

A. These initials stand for American Society of Cinematographers and indicate membership in that society

Q **I have trouble with drying marks on my negatives. Can you offer a remedy?—D. G.**

A. Make up a solution of

Sodium carbonate	1 ounce
Water . . .	10 ounces

Place the negative in the solution and warm the latter to 90 degrees, Fahrenheit. Cool the solution to 60 degrees and rinse the negative in water at 60 degrees. Now place the negative in a hardening bath, wash and dry

Q. **Is there some convenient method of making enlargements without white borders?—D. L.**

A. Every worker who desires borderless prints has his own way of achieving this end. One way is to cut five-ply board with dimensions about an inch larger each way than the largest picture you intend to make; for example, 9 by 11 inches for 8 by 10 prints. Center the paper on this board; at each corner drive an insulating staple, allowing it to project just far enough to permit slipping the corner of the paper in and out. For focusing the image, the 8 by 10 area may be painted white or you can use a sheet of thin cardboard or paper cut to the exact dimensions of the paper to be printed.

Q **Is there a remedy for bringing back to life negatives that have become dry and brittle?—S. C.**

A. There is available a formula for conditioning negatives that has given satisfactory results in many instances Here it is

Camphor	1 dram
Menthol	1 dram
Oil eucalyptus	2 drams
Glycerin	4 ounces

Q. **Will you please suggest a method for removing developer stain from negatives?—R. A. L.**

A The negative is first bleached in the following solution

Potassium permanganate .	50 grains
Table salt .	¼ ounce
Glacial acetic acid	1 ounce
Water to make . .	20 ounces

After bleaching, rinse the negative in plain water, then place in

Potassium metabisulphite	1 ounce
Water to make . .	20 ounces

Leave it in this bath until the image turns white, then redevelop the negative in any non-staining developer

• • •

WHAT'S NEW

In Photographic Equipment

GRAFLEX ANNIVERSARY ENLARGER ($87.50, including one negative carrier, but without lens) · Condenser-type enlarger for negatives up to 2¼" by 3¼". Features "variography," altering of linear perspective by means of two-way tilt of negative, tilting lamphouse, and accessory universal-tilting easel holder. Tripod-type column furnishes two anchor points for arm carrying head. Rear leg of column serves as guide for counterweight and as conduit to keep waterproof lamp cord out of way Baseboard 24 by 32 inches, leveling foot at right rear corner. Head supported near center of balance and counterbalanced by weight on other end of cable that runs over wheel at top of column. Negative triple-cooled by circulation of air, by radiation of heat from deep fins on lamphouse, by isolation from any direct metal path by which heat of lamp might reach it Double condensers in basket-type carrier that bayonet-locks in position can be replaced by diffusing screen for soft light to lower contrast of print or conceal negative blemishes. Lensboard bracket accepts Miniature Speed Graphic lensboard. Negative carrier can be used with or without glass. Head comes off to mount

camera on arm for copying, macro-photography, or photomicrography; Graflex, Speed Graphic, Graflex Photorecord Microfilm Camera, or any other may be used, as well as movie cameras for tilting and other close-up work

WATSON 5x7 PORTRAIT CAMERA ($29.50): Adjustable with reducing backs from 2¼ by 3¼ to 5 by 7 Features Tilging, swinging lens board and front, vertical, horizontal swing back, rising front board, sliding front, all-metal slide. Reversible back Full-length slide locks camera in normal position Flexible 14-inch bellows

SPEEDEX JUNIOR CAMERA ($11) Employs same design, styling and construction as original Speedex, with body shutter release, centrally-located optical eye-level finder, rapid opening, precision movement of front platform; and hinged back with safety latch Fitted with fixed-focus, four-aperture, double lens of rectilinear correction, with shutter giving instantaneous and time exposures. Loads with B2 rollfilm, taking 12 pictures in 2¼ by 2¼-inch size.

PRINCETON MOLDED TENITE SUNSHADE AND FILTER HOLDERS ($1) Available in four sizes Lens barrel—21-29mm, 31-39mm, 34-42mm, 37-45mm. Filter diameter—31 5mm, 39mm, 42mm Size 34-42mm sunshade designed for Leica and Contax cameras American made

P U BROMOIL BLEACHER (25 cents) Package consists of two glass vials with Bakelite tops, holding 16 ounces of bleacher

FOTH DERBY II ($31 with $f/3$ 5 lens, $36 with $f/2$ 5) Superimposed-image type, coupled range finder added to former model Camera takes 16 pictures on standard VP roll Shutter of focal plane type with speeds to 1/500 of a second, plus delayed action Green and dark red windows for panchromatic and orthochromatic films

ESSENKAY COLOR FILM ADAPTER ($4.50 to $6, depending on camera) Permits use of Bantam Kodachrome rolls in roll-film cameras taking Eastman 120 or Agfa B-2 film Adapter installed or removed quickly No special holes required Made to couple with automatic film stop and film counting devices on cameras. At present available for following cameras (numerals designate number of exposures per roll of Bantam Kodachrome)· Automatic Rolleiflex, 9; Super Ikonta B, 9; Rolleicord, 10, Argoflex, 8; Altiflex, 8; Wirginflex, 8, Korelle Reflex, 10; Ikoflex I, 8; Ikoflex II, 10.

MIRACLE SALON BROCHURE ($1 for 5 by 7; $1 50 for 8 by 10, $3 for 11 by 14)· "Showplace" for prints. Contrasty white-enameled metal binding. Heavy celluloid cover for mounting favorite picture as cover of Brochure Each print becomes full page of its own in book Feature of book is method of mounting brochure itself is series of narrow strips in binding, which operates on principle of first-aid bandage strips, you merely peel off glassine strip and expose adhesive-covered section Then "finger-smooth" edge of print to strip Prints may be removed at any time, without harm to print or Brochure, with provision for replacement Suggested use "double-mounting" prints, dry-mounting back to back to achieve effect of prints on facing pages Complete with adhesive strips Holds 15 regularly mounted prints, 20 to 30 back-to-back

KODASLIDE COMPARTMENT FILE, KODAK MINIFILE Box ($4.50 each) Kodaslide file box of black molded material, with matching hinged cover and latch. Inside are ten partitioned cells, each holding 20 Kodaslides Minifile box, of matching design, size, and material, supplied with 25 transparent envelopes each accepting strip of four 35mm or Kodak Bantam negatives; 25 index cards, and 25 guides having visible tabs Separator fits into notches at sides of case Extra envelopes, 25 for 35 cents; extra index cards or guides, 25 for 25 cents

HAMPDEN PANCHROMATIC MAKE-UP KIT ($1.50): For improving skin texture and facial modeling in photography Kit contains five panchromatic shades of complexion foundation, varying in color from peach to chocolate, plus three shades of powder, panchromatic lip-rouge, eye-brow pencil, eyeshadow, lip brush, and powder puff Foundation shades come in handy little wedge-shaped sticks. Illustrated booklet includes analyses of various facial types and solves individual feature problems

WESTON MASTER CINE MODEL 720 EXPOSURE METER ($24): Styled along lines of Weston Master Universal, same size and shape, using same cell and instrument movement, but calibrated for motion picture camera use. Angle of acceptance for high scale 25 degrees Extra scale for use in dim light Manufacturer claims "Model 720 will indicate a readable deflection in light levels so low that the correct exposure would be $f/1$ at 16 frames with a film having rating of 64 Weston" Top mark of 27 ample to handle brightest sand, snow and water scene.

"A TO Z" FIGURETTES ($1)· For movie title backgrounds Set includes 30 figurettes in brilliant colors. May be used over and over again; adhere instantly to wood, glass, metal or tracing paper Applied without moistening Photographs on black and white or color film Cleaned with damp cloth

AGFA TWIN-EIGHT PANCHROMATIC REVERSIBLE ($2 per 25-foot roll)· For double-width 8mm motion picture cameras Slightly slower than fast Twin-Eight Hypan Reversible, though similar in other characteristics, providing "high-quality panchromatic emulsion, brilliant gradation, fine grain, and high resolving power"

PHOTRIX UNIVERSAL PHOTOMETER MODEL B ($42.50) Equipped with instrument dial 3½ inches in width, reading 0 to 20 foot-candles in most sensitive range, intermedirte range 10 to 100 fc, high range 50 to 2000 fc Designed particularly for timing enlargements, required exposure time being determined by Photrix Enlargement Calculator, which can be inserted into lid of instrument case. Camera exposures can be timed with Photometer in conjunction with Photrix Exposure Calculator in all instances in which range or accuracy of pocket type meter is not sufficient. Other applications· densitometric measurements of negatives for timing contact prints, selecting printing papers, balancing three-color separation negatives.

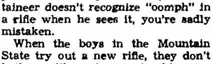
Conducted by A. D. RATHBONE, IV

INTEREST IN FIREARMS *is traditional with American men; fishing tackle is a requisite of one of the world's oldest occupations Scientific development of guns and tackle, in the use of which millions yearly find sport and recreation, fathers this monthly department which welcomes correspondence from readers*

Mountaineers Test Marlin

WE'VE just subjected one of Marlin Firearms Company's new, redesigned Model 39-A lever action .22-caliber repeating rifles to about the toughest test we can conceive of The Marlin 39-A, you know, is the only lever action repeating .22 in the world, and it's endowed with the same simplicity of breech action and construction that helped make John Marlin's name famous over 49 years ago (See May, 1940 issue). Latest refinements on this sweet shooting little gun include redesigned receiver, shortened tangs to permit remodeling of buttstock and to allow the comb to be moved farther forward Coil main and trigger springs have replaced the flat steel type, producing smoother and easier working action.

We took this Marlin 39-A into the mountains of West Virginia, where the present generation of gunners are direct descendants of some of the straightest shooting rifle shots this country ever knew Many things in the Mountain State have changed since the time of the great-great-granddaddies of today's shooters, but the West Virginian's demands on a rifle, small caliber or large, are just



Marlin 39-A

as stringent now as they were when accuracy and speed of operation meant preservation of life The gun must feel right, sight quickly and truly, shoot straight and hard, and if you think the present day mountaineer doesn't recognize "oomph" in a rifle when he sees it, you're sadly mistaken.

When the boys in the Mountain State try out a new rifle, they don't bother with such prosaic things as Army L targets or any other kind They, like their fore-fathers, are in the habit of shooting wild turkeys in the head, and that, gentlemen, is a real mark at which to shoot. Nor do West Virginia mountaineers use a vise of any nature to hold the gun steady for a target test If you can hold an old 9-pound muzzle loader on a wild turkey's head long enough to put a lead ball 7/16 of an inch in diameter through said head, you don't need a vise

No, they do it this way. They cut a piece of white paper about two

Mitchell and "Ol' Yella Jacket"

inches square and peg it with four whittled pegs to a block of stove wood, which preferably has been darkened by weather They pace off 60 yards and lay a log on the ground at right angles to the course of fire. Stretched prone behind the log, they rest the front of the gun barrel on the log, but—and this is important—they do not support the fore-end of the gun with the left hand as we "civilized" target shooters do. They bring the left hand back so it can grasp the bottom corner of the buttstock where it projects slightly below the shoulder The right hand takes the normal trigger position, but the left steadies the gun and prevents canting to left or right.

The results? Three West Virginians, none of whom had ever seen this Marlin before, each fired five shots (.22 long-rifle cartridges) at the target from the prone position. Of the total of 15 shots, 9 were well within the square of paper, two clipped the edges and the remaining four were in the wooden block, just off the paper's edge. The performance was repeated by three more shooters at the same range and this time only two shots missed the paper. The verdict? That portion of West Virginia's male population which did the shooting, as well as the onlookers, ungrudgingly and enthusiastically

voted this new Model 39-A Marlin to be one of the best shooting rifles it had ever seen.

Said Hugh Mitchell, one of the best of the marksmen, and a man to be feared in any shooting competition, "'Deed, Ah reckon this little gun is about the nicest shootin' rifle I've handled since my granddaddy gave me Ol' Yella Jacket." And by way of explanation, "Ol' Yella Jacket" is a 9½ pound muzzle loader with a 40-inch octagonal barrel 3 1/16 inches in circumference, a bore of 7/16 inches, and it still shoots a lead ball straight enough to take that wild turkey's head right off from the top of his neck. During the past three generations Mitchell's "Ol' Yella Jacket" has won more shooting matches than any other rifle, antique or modern, in that section of West Virginia's mountains, so praise from Mitchell is real praise.

Outboards for Ducks

UNDER provisions of the Federal Migratory Bird Treaty Act, ducks and other migratory game birds may not be hunted from a power boat, and a boat to which an outboard motor is attached is unequivocally within that category. However, like the lad in the picture, the hunter may use his Evinrude or Elto to propel his boat to hunting location, then he shoots from

Ducks . . . and outboards

the boat *after* the motor has been detached and placed inside the craft. Obviously, he may re-attach the motor, after hunting is over, to return home. Just to be sure on this point, we asked the Fish and Wildlife Service, Department of the Interior, and have their word that the above is the correct interpretation, but by all means take that motor off the stern before you start pulling triggers, or you'll be in trouble with Uncle Sam.

Strange Guns in Strange Places

IN 1842, Henry Deringer, Jr., manufacturer of famous pocket pistols that bore his name, received one of the contracts to furnish the United States Army with its first percussion pistols. In Brandon, Vermont, 29 years earlier, and in Hartford County, Maryland, three years earlier, were born two men, both of whom were destined to own famous Deringers and to bitterly oppose Abraham Lincoln.

The man from Vermont was Stephen Arnold Douglas, who ran against Lincoln in the Presidential election of 1860, and who later gave the martyred Chief Executive unfaltering support. The Deringer owned by Douglas had an engraved lock and hammer, with the word "Philadelphia" stamped on the former. On the German silver name plate, which also served as butt-strap, was engraved "S. A. Douglas." Before Stephen Douglas died in 1861, he presented his pistol to J M Tenny, then proprietor of the National Hotel, in Washington.

On the 14th of April, 1865, the man from Hartford County, Maryland, carrying a Deringer identical in every way to the one formerly owned by Douglas, save for the engraving of his name, slipped into a box in Ford's Theatre, in Washington, and shot President Abraham Lincoln. That man was John Wilkes Booth. It's a strange coincidence that Booth should use a facsimile of the pistol which belonged to Douglas, Lincoln's opponent for the Presidency. If you drop into the office of Francis Bannerman Sons, New York City, to whom we are indebted for this tale, and ask to see their extensive firearms collection, or if you'll browse through their annual "Military Goods Catalogue," you'll find many examples of "strange guns in strange places." Have you a story about "strange guns?" We'd like to hear it.

Hoffman Arms

IN tune with the growing demand from shooters for high quality, custom-built guns at moderate prices, The Hoffman Arms Company, a sterling name in the firearms world some years ago, has been fully and capably reorganized at its new plant in Amarillo, Texas, and is actively engaged in producing rifles and shotguns to

Captain Charles Askins, Jr., and his Hoffman .30-'06 sporter

the customer's measurements. After three years of careful preparation, including acquisition of a factory, selection of skilled artisans, purchase of gun-maker's steel, barrel stock, Circassian walnut, and a vast complement of tools and machinery, James A. Hedgecoke, millionaire cattleman, sportsman and sole owner, and B. R Polley, general manager and one of the ablest of gun builders, announce they are prepared to serve America's discriminating gunners.

The Hoffman Arms Company is a complete manufacturing plant, not a mere assembly shop, and every rifle and shotgun will be entirely custom-turned from front sight to buttstock in rifle calibers from 22 to 50, and in side-by-side, double barrel, English type field scatterguns of 12 and 28 gage and 410 bore Delivery is guaranteed in two weeks on 22 long rifle, 220 Swift, .250 Savage, 6 5 and 7 mm., 276 Dubiel, 30'06-300 Magnum, 375 and 404 Magnum, and on the above named types of shotguns Six weeks are required for production of other calibers In short, here is the American shooter's long-awaited chance to own that much desired custom-built gun at a moderate price, for Messrs Hedgecoke and Polley announce their prices will be "tens of dollars beneath the usual cost of guns of this high quality" We'll be pleased to send along further details of The Hoffman Arms Company prospectus, it is mighty absorbing

Gun Book of the Year

ALL too seldom in these days of mass publication there appears a book which causes one to gasp in amazement at the author's comprehensive treatment of the subject, to exclaim in admiration at the beauty of compilation, illustrations, and binding, and to marvel at the thoroughness and simplicity of presentation Such a volume is "A History of the Colt Revolver," by Charles T. Haven and Frank A Belden, who spent years in research, planning, and consultation with other eminent arms collectors and experts in preparing their work It is a magnificent publication of over 700 pages, 8 by 11 inches, containing 500 illustrations

In four parts, devoted respectively to history, from earliest known guns to modern Colts, an outline of the antique and obsolete models of Colt arms and their several variations; photostatic reproduction of documents contemporaneous to manufacture of Colt arms from 1832 to 1940; and facsimiles of a number of patents on the Colt revolver, the book not only is completely indexed, with a glossary, but also is arranged with Table of Contents showing chronologically the development of the revolver "A History of the Colt Revolver" will prove to be an encyclopedia for the arms collector, an invaluable correlative volume for the historian, and a source of endless enjoyment and information for the layman.

Last month we mentioned our compilations of books reviewed during the past year. There are four of these lists, covering publications in the fields of firearms, fishing tackle, gun collecting, and natural history, and the only cost is a 3-cent stamp for return postage.

Insurance for Fishing Tackle

COMES now the time when anglers in northern zones, wistfully, with poignant memories, store away their tackle for the winter. The more care given to rods, reels, lines, lures, and boots when the frost is on the pumpkin, the better condition the gear will be in when ice goes out next spring and the first timid buds and hardy arbutus issue their annual siren call to hibernating fishermen Hang boots heels up in a dry, cool place Check rods carefully for loose ferrules, worn guides, cracked agates, and the protective coat of varnish If the big-one-that-got-away left you a cracked or broken section as a souvenir, send the rod to the factory that made it

To those who know how, removal of guides, windings, and worn varnish preparatory to application of the new coat and new wrappings is not a difficult fireside chore for winter evenings In fact, it's fun and a good time to dream of new conquests, but if you've never done it, and if your's is a prized rod, it's best to trust the folks who made it Too much varnish and poorly applied windings may completely alter the rod's action Avoid excessive moisture or heat in storing rods and never leave them standing in the corner They'll come out parabolically inclined Store either in their aluminum cases or hung up whole or in sections perpendicularly on the wall by tip and by guide

Reverse silk lines on the reels and thoroughly clean the reels themselves, and it's good insurance to alter the position of the click so a new point of the triangle will receive next season's wear. Enameled trout lines keep best off the reel, coiled and hung in large loops, preferably with support at many points, such as a 10-inch tube of blotting paper Dry leaders, wash out leader boxes and moistening pads As to trout flies, bass bugs, and other lures containing delectable tid-bits relished by moths, protect them in their cases or boxes with particles of moth balls or other repellents

Winter is a good time to clean out the tackle box, sharpen up hooks on bass plugs, put a drop of oil on shiny spoons to keep them that way, and generally to take inventory to see what is needed. Christmas is coming, you know, and so are 1941 catalogs from Messrs. DeWitt, Heddon, Pflueger, Mills, Shakespeare, South Bend, Weber, and others. They'll be chock-full of splendid gift suggestions for the men of the house, and for milady Walton, too, especially if properly marked with a large, red pencil.

Our Book Corner

THE BOOK DEPARTMENT of Scientific American is conducted, with the co-operation of the Editors, to make available for you a comprehensive book service. Each month the Editors select and review in these columns new books in a wide range of scientific and technical fields In addition, they are ready at all times to advise you regarding the best available books on any subject. You are invited to use this service freely. Tell our Book Department what kind of books you want and you will be furnished with a list of available titles, including prices. When inquiring about books, please be specific; remember that we can be of the greatest help only when you tell us just what you are looking for.

BRITISH WARSHIPS, THE ROYAL NAVY

By The Illustrated London News

PICTURES, text, and data concerning all the ships of the Royal Navy Some of the illustrations, particularly of the larger ships, are full-page size, while there are also a number of cutaway drawings showing interior arrangement of ships—supply rooms, service quarters, and the like Drawings also show armor protection of a number of the battleships All data are extremely complete (40 pages, 19 by 12½ inches, stiff paper binding, cover printed in gold and blue)—$1.25 postpaid —*F D. M*

LIFE ON OTHER WORLDS

By H Spencer Jones

AT last a professional astronomer has written a whole volume on this most intriguing of all subjects connected with astronomy And he has written neither as a radical nor as an ultra-conservative That is, while the author's conclusions will scarcely feed the panting sensationalist with the "hop" he craves, he does not show any desire to play down the big question. What he does is to treat it just as the evidence of astronomical science appears to call for at present The question is discussed for each planet Readers will like the 17 illustrations—not of imaginary Martians but photographs of star clouds, nebular, lunar close-ups, spectra of planets, Mars and clouds on Mars, Saturn, Venus—all large and attractively produced (299 pages, 5 by 8 inches, 17 plates)—$3 10 postpaid —*A G I*

THE STEEL SQUARE

By Gilbert Townsend

HOW to use its scales, lay out braces, rafters and roof framing in general, and do other work Written by a Montreal architect (96 pages, 5½ by 8¼ inches, 102 illustrations.)—$1.35 postpaid.—*A G I.*

AIRPOWER

By Major A. L. Williams

MAJOR WILLIAMS has had a brilliant career as a naval aviator in the World War, with many flight records and other exploits to his credit. For many years he has been a close and brilliant student of military aviation and has written widely on this subject His 1938 European tour (in his own single-seater) gave him a fine opportunity of studying at first hand the air equipment and strategy of both Germany and Italy In "Airpower" he presents a graphic picture of such milestones in aerial warfare as the campaigns in Ethiopia, Spain, Poland, and Western Europe His review of these campaigns and his views on the use of aircraft in modern warfare are of the greatest value and are most timely when the United States is faced with vital problems of national defense. We can almost forgive this splendid technician his hostility to England, his mistaken isolationism, because he brings us such a fine understanding of the problems of airpower and national defense —$3 60 postpaid —*A K.*

GRAPHIC PRESENTATION

By Willard C Brinton

AN excellent guide for all those interested in depicting statistics, flow of materials in production, flow of traffic along highways, progress, chronological, dot and pin maps, pictorial charts, multiple bar and contrasting bar charts, sector or "pie" charts, and numerous other modern "pictographs." A statement quoted in the book from Henry D Hubbard of the National Bureau of Standards well describes the use of these various types of charts "There is a magic in graphs. The profile of a curve reveals in a flash a whole situation—the life history of an epidemic, a panic, or an era of prosperity" (512 pages, 6¼ by 9¼ inches, leatherette cover, hundreds of illustrations)—$5 10 postpaid—*F D M*

A HISTORY OF THE COLT REVOLVER

By Charles T. Haven and Frank A. Belden

FOR over 100 years this nation has owed a debt of gratitude to Colonel Samuel Colt for his invention of the first practical firearms with combined automatic revolving and loading of cylinder. Without that device, settlement and control of the West, the successful termination of the Seminole Indian trouble and other episodes in later American history might not have terminated so satisfactorily Today, that debt has expanded to include the authors of this comprehensive, factual publication and Colt's

—OUR BOOK CORNER—

Patent Fire Arms Manufacturing Company for its splendid co-operation. In writing the foreword for the book, Stephen V Grancsay, Curator of Arms and Armor, The Metropolitan Museum of Art, said: "The authors of this volume have filled a serious gap in the literature of firearms. . . Without venturing into the field of eulogy, it may safely be said they have scored a bull's eye." The book is in four parts which respectively cover the history of Colt arms, an outline of antique models, photostatic reproduction of pertinent documents from 1832 to 1940, and facsimiles of Colt patents. Completely indexed, with glossary. (711 pages, 8 by 11 inches, 500 illustrations.)—$10.10 postpaid —*A. D R., IV.*

STAIR BUILDING

By Gilbert Townsend

DESIGNING and laying out stairways is not a job for a hatchet carpenter but if the style is uncommon, and is to be real architecture, it requires considerable study and labor Many books sold to tradesmen are out-of-date and poorly produced but this one, by a Montreal architect, is modern and pleasing. It covers types of stairways, common and uncommon, their arrangement in house plans, their geometrical layout and their construction and finishing All practical (200 pages, 5½ by 8¼ inches, 195 illustrations.)—$2 10 postpaid —*A G. I.*

CHAMBERS'S TECHNICAL DICTIONARY

By thirty experts under editorship of C F. Tweney and L. E. C. Hughes

PRACTICALLY no scientific term in common use today, whether it be Nipkow disk, endosome, motional impedence, or any other such strangely familiar but unfamiliar term, is missing from this carefully compiled volume. The best recommendation we can give is the fact that this review copy will go on our editorial shelves, pushing aside all similar preceding volumes. It is exactly the type of reference for which we have searched these many years (957 pages, 5½ by 8¼ inches, unillustrated.)—$5.10 postpaid —*F. D M.*

AN INTRODUCTION TO ENTOMOLOGY

By John Henry Comstock, Late Professor of Entomology, Cornell University

THE ninth and once more revised edition of a textbook which has long been a standard In its opening 205 pages it covers the characteristics, anatomy, and metamorphosis of insects in general—scientifically, systematically. The following 802 pages consist of a full, detailed, orderly classification of insects, giving their life histories—one or two pages of compact data on each of many specific insects, with illustrations. The re-

mainder is a detailed bibliography and index. Not written primarily to amuse the reader, this is a work for the student. It is also a reference book for all who, from time to time, wish to identify insects and look up dependable data about them from the foremost scientific source on entomology. (1064 pages, 6 by 9 inches, 1228 illustrations)—$5.15 postpaid. —*A. G. I.*

SIMPLIFIED CARPENTRY ESTIMATING

By J. Douglas Wilson and Clell M Rogers

IN this compact, practical little book everything concerning the taking off of a bill of materials for a house is clearly set forth, and all the rules for making an accurate cost estimate are arranged for convenient use (204 pages, 4½ by 5¾ inches, 70 illustrations.)—$2 60 postpaid —*A. G I*

WHAT MAKES THE WHEELS GO ROUND

By Edward G. Huey

PHYSICS for youngsters of age not less than 11 (unless unusually keen), remarkable as it may seem, is possible Judging by concrete tests made on one average lad of ten, who stumbled over some of the harder words, age 11 is the minimum for this book The subjects covered are those of regular physics—solids, liquids, gases, magnetism, evaporation, inertia, friction, sound, and so on—but they are not dealt with heavily The style, instead, is bright and sprightly There is also a leavening of explanations of common things such as locomotives. This book provides a good chance to test whether your young hopeful has a budding mind of the type likely to make a good scientist (175 pages, 7½ by 9½ inches, illustrated.)—$2 60 postpaid —*A G I*

GUNS ON THE FRONTIER

By William MacLeod Raine

WHEN, in Chapter Three, the author wrote, "All frontier communities have had to discover that law is not a lot of words written in a book," he succinctly described this work The story of the struggle for law and order in early western settlements is graphically, authentically, and most entertainingly told. All the noted "bad men" are delineated with a clarity, vividness, and understanding of their quirks of character which would almost seem to tag the author as an eye witness. It is, however, his long residence in the Southwest, coupled with intense research for his numerous other books on frontier life which have been combined to portray skilfully this new picture of the bad man who lived his short, violent day before organized law was finally achieved. (282 pages, 5½ by 8 inches, 11 illustrations, index of characters)—$3.10 postpaid.—*A. D. R., IV.*

A Monthly Department for the Amateur Telescope Maker

Conducted by ALBERT G. INGALLS

As the telescope making hobby continues to spread, the tendency to want permanent housings for the telescope increases; they save a lot of bother, and greatly add to comfort in cool weather W L Moore, Coral Ridge, Ky, is the maker of the one shown in Figure 1 The lower struc-

Figure 1. **Moore's observatory**

ture serves as a tool house The dome above it is itself 10′ in diameter and 8′ high Its upper or hemispherical part is made of 28-gage sheet metal, with ribs similar to those suggested by Scanlon in "Amateur Telescope Making—Advanced" The vertical or skirt part is made of corrugated metal Contrary to first appearances, however, the two parts are permanently attached to each other, an arrangement which affords a little more headroom at the sides This puts the rollers, which are ball bearings from junked cars, down at the level of the observing floor Moore says he can push the whole dome around with one hand Inside, at present, is an 8″ reflector

Chief value of studying others' work, before undertaking one's own, lies in finding what mistakes others made and not repeating them Asked, therefore, what, if anything, he would not do again, Moore stated that he placed his stone pier, 30″ square, in the center of the dome, not realizing that if he ever wants to use a German or a fork mounting it will then be off-center "If I built again," he points out, "I'd also make the seams in the dome a little higher I turned up 1″ on one side and ½″ on the other but I should have made these 1½″ and 1″, respectively, so I had some trouble with leaks, having to use a lot of solder at the low places I also made the frame of my shutter, which carries its two pieces of 36″ sheet metal, too light and it rubs on the dome frame, making it a bit hard to open the shutter This wooden shutter frame rides on barn-door rollers."

A fat collection of "Things I'd Never do *That* Way Again" would be a big practical help in amateur telescope making. Who is there who couldn't contribute a few! Open invitation

From Clayton F Howe, 514 Arthur Ave., Kalamazoo, Mich., comes this note "Here are photographs and a sketch (Figures 2, 3, and 4) of a turret eyepiece holder I have recently finished for use with my telescope. Holding a battery of three eyepieces of differing focal lengths, it is the most useful piece of equipment I have, next to my finder

"The turret, made of aluminum, floats around on a thin film of oil and doesn't upset the aim of the telescope as changing eyepieces in the usual way often does In freezing weather I plan to try substituting glycerine for oil

"For convenience of representation, in the drawing, the spring-ball holder is shown opposite the large boss but, as Figure 3 shows, it actually is at one side of it This permits the holder to be mounted nearer the main telescope tube

"The eyepiece tubes were threaded into the turret while the whole assembly was mounted on a lathe arbor,

Figure 2: **Howe's turret rig**

consequently they are absolutely perpendicular

"I am making a couple more for local TNs I made my own patterns, and the castings from these cost me only 50 cents a set Brass tubing was two bits and the remainder came from the scrap box"

While turning over files of telescoptical items from previous years, your scribe encountered an article from *The Journal of the Royal Astronomical Society of Canada*, Sept. 1937, in which H S McClung, of Regina, Saskatchewan, described what he calls the "corneal reflex test." Suppose, in the regular set-up for the Foucault test, that the lamp and pinhole were removed and a small ball were substituted for it, with a strong light somewhere in front but off to the side Then the tiny reflection of the light on the curved ball would in effect become the pinhole This, of course, has often been done; sometimes a drop of mercury is used, or a small marble of glass, or any spherical reflecting substance

The ball used by McClung, however, is the ball of the eye itself. This permits the effective light-source—that is, the reflection of the lamp on this ball—to lie very close to the knife-edge, thus avoiding astigmatism due to separation of pinhole and knife-edge. McClung says the light used should be strong but need not be very small in area This light may be a disadvantage, shining, as it would, in the eye when the latter was studying the subtle shadows on the mirror It is also hard to hold the head steady enough to conduct this test, and McClung suggests a headrest However, some may like it Have many been using it, since McClung published it?

Years ago in this department there was a note about using the edge of the pupil of the eye as the knife-edge and dispensing with the ordinary one. This, too, required considerable steadiness on the part of the tester Maybe some readers will want to compound these two We don't necessarily recommend either one for regular testing but as a variation they are interesting—like riding a bicycle while standing on your head on the seat—that is, a bit tricky

In this department, October, 1935, Joseph A McCarroll, of Teaneck, N J, described a penetrometer for reducing the hardness or softness characteristics of pitch to a quantita-

Figure 3 **Turret. Another view**

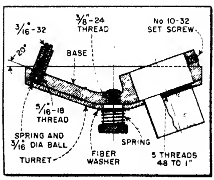


Figure 4: **Section of turret**

tive science, and, in the October, 1936, number, two more penetrometers were described. Now comes Robert E. Smith, D D.S., Medico-Dental Bldg., Sacramento, Calif., with the one shown in Figure 5. It is made from sundry pick-me-ups, plus an optician's diopter gage to register the time-depth penetration of the point into the pitch at given temperatures. The point

Figure 5: Smith's penetrometer

is shown above two pitch facets Using this, Dr Smith claims he knows all the time, as he works with pitch, where he is "at"

Among amateur glass polishers you can always get up an all-night argument about the merits and demerits of various pet fine-finishing abrasives Here's a comment by D Everett Taylor, 191 Prospect St, Willimantic, Conn

"For a final step in fine grinding, before rouge, use extra fine emery in kerosene, as the grains break down easily and smoothly when so used and are much less likely to cause fine scratches"

With regard to Levigated Alumina he says, "This is a buffing flour for polishing metals and, for this purpose, it undoubtedly is tops, but when the microscope revealed that it had an extremely small grain size its use also for superfine finishing of optical surfaces was recommended ["ATM," 4th edition, pp. 296, 493 —*Ed.*] If you are intent on using Levigated Alumina for fining glass surfaces, watch out for fine scratches"

Taylor states also that there is a glass removal of about a thousandth of an inch, between the kind of surface left by Carbo 600 and one sufficiently fined with fine flours, to be called ready for polishing. He says also that 0.0003" of glass must be removed in order to eliminate fine scratches of the kind that require magnification in

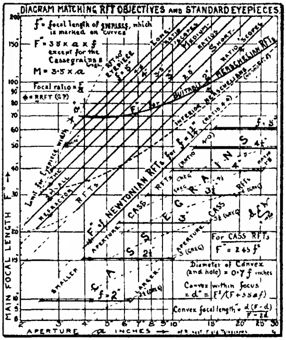


Figure 6: **Walkden's matching data**

order to be seen. Asked how he determined this, Taylor replied that the statement is based on a measurement of a lens before and afterward, using a Starrett micrometer.

INTEREST in Walkden's Richest-Field Telescope, or "RFT," continues, and many have been made. In the following contribution Walkden, whose address is 46 Cavendish Road, Harringay, London, N 4, England, discusses the matching of RFT eyepieces and objectives.

"If an amateur has an objective and wonders what eyepiece he needs to make it an RFT, he can get the answer from the accompanying diagram without even a calculation; or, if he has a few eyepieces or their lenses lying around and wonders how he could use one, if possible, for an RFT, the diagram again answers without calculation.

"A natural way of designing an RFT is to start with the aperture, a'', then decide on the focal ratio, c, then the focal length, F", and, finally, proceed to the eyepiece focal length, f'', and the particulars of the lens. But among the eyepieces available is likely to be one not exactly but only nearly what is needed, and then, taking that nearest, we soon find ourselves working back to the main focal length and the aperture, in a matching process.

"Now the diagram of Figure 6 performs this matching process very quickly for every type of RFT—refractor, Newtonian, Herschelian, Cassegrainian and even Gregorian—and it also shows at a glance the various alternatives we might prefer to what we originally thought of constructing.

"Suppose, for example, we have in possession, or in makers' lists, a 1¼" RFT eyepiece. Looking at Figure 6, and at the sloping line for the 1¼" eyepiece, the eyepiece is seen satisfactorily to complete any Newtonian RFT of from 4" to 12" aperture, the proper focal length being read on the left-hand scale, where it is 4.4 times the aperture, agreeing with the formula near the top. The eyepiece can stretch over the range of 3" to 15" or even 20" aperture, but Newtonian RFTs of less than 4" aperture are not good, being too much choked by their flats, and Newtonians of 15" and 20" aperture are better with eyepieces of 1¾" and 2" focal lengths and main focal lengths of 92" and 140", and even then they hardly equal large Herschelians. While considerable margin is allowable, especially for eyes not very sensitive to the blind spot (image of the flat) in the center of the Newtonian's Ramsden circle, it is always as well to keep in mind that for an eyepiece of f inches focal length, the best aperture under the minimum-obstruction rule is given by $a = 4.9\ f^2$ inches. But eyepieces of less than 1" should not, and over 2½" need not, be considered candidates for Newtonian RFT construction, and the apertures of less than 3", and even 4", are really not allowable. The "best" Newtonian line, $a = 4.9\ f^2$ or $F = \sqrt{2}\ 5\ a^3$, may be seen to cross steeply the 1¼" eyepiece line at 7.6" aperture.

"If we have only the 1¼" eyepiece we should not think of any other RFT than a Newtonian of moderate aperture; but suppose the RFT eyepiece is of 3" focal length. This 3" eyepiece can be seen to complete any refractor RFT of over 2¼" aperture, of about the focal length to be read on the left-hand scale, 10.5 a inches, corresponding to the formula near the top. Or, paying regard to the thick Herschelian curve, the eyepiece will complete good Herschelian RFTs of about 5" to 10" or even greater apertures, all of the same focal lengths as refractors, or like the formula near the top.

"Should our preference be for a Cassegrainian RFT, the 3" eyepiece will complete any such RFT of 22" main focal length, ranging in aperture from about 5¾" to 14½", chosen larger according to experience and skill in figuring mirrors of small focal ratios when aided by Kirkham's scheme of using a spheroidal small convex mirror (see Scientific American, June, 1938). The formulas in the right hand lower corner may also aid the constructor; and the peculiarity of the Cass RFT may throughout be noticed, that the focal length of the eyepiece primarily determines only *the focal length* of the main mirror, leaving the aperture to be chosen from independent considerations.

"Should a Gregorian RFT be chosen (although it gives little reason for being liked), the 3" eyepiece will complete such an instrument, ranging from a 4¼" of 11" focal length to a 10" of 16" focal length

"In another use often required of the diagram, suppose we have already decided on 6" aperture, and have the choice of several RFT eyepieces Proceeding upward from the bottom of the diagram at 6" aperture, we can evidently have a 6" Cass RFT of 9.8" main focal length, employing an eyepiece of 2" focal length And the Cass rules in the right-hand lower corner tell how the convex and the hole are both to be of 1.40" diameter, also how the convex is to be 1 85" within the main focal point, and be of 2 42" focal length. The alternative Cass RFTs of greater focal lengths, employing larger eyepieces, are easier to make, but they are less and less efficient.

"In 6" Gregorian RFTs we can have one of 10" main focal length, employing a 2½" eyepiece, but it is not a very good instrument. The alternatives of longer focal lengths, employing larger eyepieces, while easier to construct, are even less efficient.

"The 6" Newtonian RFT is one of 26" focal length, employing a 1¼" eyepiece, and is the useful handy kind of RFT which is perhaps the most liked, until the virtues of the Herschelians come to be further realized Again, in connection with Newtonians, the 6" mirrors can be matched by others than the recommended 1¼" eyepieces. The 'best' eyepiece corresponding to minimum-obstruction design is always of focal length equalling 0 45 $\sqrt{a}$ inches, which is 1 10" for a 6" mirror, but the insensitiveness of some eyes to the blind spot in the Newtonian's Ramsden circle allows of considerable variation in the eyepiece focal length. When f is decided upon, the mirror must always be made of focal length $F = 3\,5fa$ inches, and the flat be arranged according to the rule given in 'ATMA' An aperture less than 3" or even 4" should not be assumed for a Newtonian RFT—and an aperture greater than 25" perhaps need not be assumed.

"The 6" Herschelian RFTs begin to be quite good at 63" focal length, employing a 3" eyepiece, but 72" focal length, using a 3½" eyepiece, proves better in definition. Only the fastidious might want still greater focal length employing a still larger eyepiece. It is curious to notice that the *larger* eyepieces go with the *smaller* Herschelian RFTs, contrary to the rule for the Cassegrainian and even the Newtonian RFTs."

As no 3" eyepiece is known to be available on the market, the amateur must make his own. For this, Walkden gives the following data on a Ramsden of the usual two plano-convex lenses. Focal length of each lens, 4". Distance of lenses apart, 2.67" Diam. of field lens, 2.31", of eyelens, 1.3". Eye-hole distance suiting smallest need, 7/8". Eye-hole diam., ½".

Patent, Trade Mark, and Related Legal Proceedings That May Have a Direct Effect on Your Business

By ORSON D. MUNN, Litt.B., L.L.B., Sc.D.

New York Bar
Editor, Scientific American

Reissue

THE Supreme Court has held that a charge of patent infringement cannot be maintained against a defendant who acquired and used a machine subsequent to the granting of an original patent, which did not infringe that patent but which does infringe the claims of a reissue patent applied for subsequent to the time when the machine was acquired

In the case in question a patent was obtained on a machine for treating nuts by mixing butter therewith so as to make them more appetizing. After the patent was issued the defendant purchased and used a machine for the same purpose which did not infringe the patent Subsequent to the time that the defendant purchased the machine the patentee applied for and obtained a reissue of the original patent The reissue patent was of broader scope than the original patent and several of the claims were infringed by the machine acquired by the defendant

The controversy arose over the charge of the patentee that the defendant's machine infringed the reissue patent The Court held that by acquiring the machine which did not infringe the original patent during the period between the granting of the original patent and the filing of the application for the reissue, the defendant had obtained intervening rights which permitted him to continue using the machine even after the time that the reissue patent was obtained The Court pointed out that when the original patent was granted it was presumed that everything not claimed therein was dedicated to the public by the patentee and that anyone had a right to rely upon this presumption Under the circumstances the patentee was held to be estopped to enforce the reissue patent against the defendant

Privacy

A FEDERAL Court has recently sustained the right of a periodical to publish news articles describing the intimate details of the private life of a person regarded as a public figure

A popular magazine published an article describing the life of a man, who in his childhood and youth, was widely heralded as an infant prodigy The article described his early brilliance and accomplishments and the widespread attention and publicity which he received. It then described his general breakdown and the revulsion which he afterward felt for his former life of fame and study. The article pointed out that he attempted to conceal his identity and to escape publicity by choosing a career as an insignificant clerk.

Suit was filed by the unwilling subject of the article, contending that it constituted an unwarranted invasion of his privacy The Court, however, disagreed with this contention and dismissed the complaint, holding that the article was not an illegal invasion of his right of privacy In reaching its conclusion the Court first pointed out that it was not contended that any portion of the article was untrue The Court conceded that it was "merciless in its dissection of intimate details of its subject's personal life" On this point the Court ruled, however, that the facts with regard to even the private lives of persons regarded as public figures had legitimate news value, and as such, could be published by a periodical

The reasoning of the Court in reaching its conclusion is set forth in the following quotation from its opinion "Revelations may be so intimate and so unwarranted in view of the victim's position as to outrage the community's notions of decency But when focused upon public characters, truthful comments upon dress, speech, habits and the ordinary aspects of personality will usually not transgress this line Regrettably or not, the misfortunes and frailties of neighbors and 'public figures' are subjects of considerable interest and discussion to the rest of the population. And when such are the mores of the community, it would be unwise for a court to bar their expression in the newspapers, books, and magazines of the day"

Bad Faith

IT has recently been held by the New York Supreme Court that a manufacturer, who falsely and in bad faith notified the customers of a competitor that he was the owner of a trade mark and that it was duly registered in the United States Patent Office, was guilty of unfair competition

In the case in question the ownership of the trade mark was in dispute between two competing manufacturers The trade mark was not registered by either of the manufacturers in the United States Patent Office. In spite of this fact, one of the manufacturers notified the customers of

the other that he had registered the mark in the Patent Office and that it was protected by the federal trade-mark laws.

The injured manufacturer brought suit charging unfair competition and the Court sustained the suit holding that the false notices, sent in bad faith, constituted unfair competition While the injured party sustained a moral victory, and no doubt a certain amount of consolation from the victory, he did not receive any tangible recompense for his injuries The Court held that the damages were of too speculative a character to be definitely ascertained and awarded only nominal damages in the amount of one dollar

Inescapable

In a decision which is unusual only in that the conclusion reached is so obvious that a layman might wonder why it was necessary to obtain a judicial determination, it was held that a talking moving-picture is a moving picture The owner of a copyright on a play granted the exclusive motion-picture rights in the play to a moving-picture producer who subsequently produced a talking moving-picture based on the play It was contended by the copyright owner that the talking moving-picture infringed his copyright since he had not granted the right to use the dialogue

The copyright owner argued that according to a custom in the industry the granting of motion-picture rights in a play did not in and of itself give the right to use the dialogue The Court rejected this argument, however, pointing out that the copyright owner had granted the exclusive motion-picture rights to the producer and that a talking motion-picture was undoubtedly a motion picture

In this connection the Court stated "The plaintiff cannot escape the obvious conclusion that a talking motion-picture is a motion picture."

Paint Remover

A process for removing paint by means of infra-red rays was held to be patentable by the Court of Customs and Patent Appeals The process consisted of generating a beam of infra-red radiation substantially parallel to the internal line focus of an elongated reflector, and then externally focusing the rays upon a paint-covered surface The Patent Office held that the process was not patentable in view of a prior patent which disclosed the use of infra-red rays without a reflector for the removal of paint

The Court reversed the Patent Office and held that the process as described above was patentable because it was not only new, but also produced useful and improved results over the old method which did not employ a reflector

(The Editor will appreciate it if you will mention Scientific American when writing for any of the publications listed below)

INTRODUCTION TO POLARIZED LIGHT AND ITS APPLICATION, by Martin Grabau, is a 46-page booklet that presents in compact form a complete survey of the principles of polarized light; it continues with brief descriptions of the uses of polarized light and the advantages that can be obtained. It covers a number of industrial applications. A bibliography points the way toward more comprehensive study. *Polaroid Corporation, Cambridge, Massachusetts.—50 cents.*

RECREATIONAL RESEARCH is a 64-page booklet which presents the findings obtained as a result of observing and studying various recreational projects It deals with both historical and recent trends as well as the general sociological effects of leisure-time occupation It also goes into such phases as economic effects, professional aspects, and personal health as influenced by recreation. *G. M. Glass, School of Health, Physical Education and Recreation, Louisiana State University.—$1 00.*

TENITE SPECIFICATIONS is a 28-page book that presents first a classification of the various types of this plastic and then proceeds to give in tabular form specifications regarding them *Gratis to manufacturers, molders, and designers Tennessee Eastman Corporation, Kingsport, Tennessee.*

FOTOSHOP HANDBOOK OF COLOR is a 102-page book containing a complete description of every type and make of color camera and accessory The book also includes thorough laboratory instructions for all the popular color-printing processes, technical data on all films and filters, light and equipment related to color photography, a course in the fundamental principles of color photography and a complete supplement devoted to comprehensive reviews of books on color photography. The book includes five pages of natural color photographs by outstanding color photographers, printed in four colors. Stainless steel wire binding, cross-indexing with manila separators, periodic supplements without extra charge, moisture proof, chemically resistant cover printed in six colors, merchandise directory, are other features. Size 5¼" by 8¼". *Fotoshop, Inc., 18 East 42nd St., New York, New York.—$1.00, refundable on cumulative purchases totaling $10 or more*

THE NURSING CARE OF PATIENTS WITH INFANTILE PARALYSIS, by Jessie L. Stevenson, R. N., understandably deals with the practical care of patients having that disease, and is furnished by the foundation which has been linked with the President's Birthday Fund. *The National Foundation for Infantile Paralysis, Inc., 120 Broadway, New York, N. Y.—Gratis.*

DEVELOPMENT AND MANUFACTURE OF OPTICAL GLASS IN AMERICA, by M. Herbert Eisenhart (President of the Bausch and Lomb Optical Co.) and Everett W. Melson, is a reprint of a technical article. *The authors, Bausch and Lomb Optical Co., Rochester, N. Y.—Gratis.*

MU-SWITCH is a 10-page catalog giving complete information on a series of switches that have wide industrial and experimental applications. These switches are of a type in which a very short movement of the actuating mechanism—only .001 of an inch—gives positive make and break. Through a reverse-action cross-center principle, the action of the contacts is sufficiently rapid to prevent arcing. The switches are available in a number of different styles having wide variety of purposes and are designed to handle loads up to two kilowatts. *Mu-Switch Corporation, Canton, Massachusetts. —Gratis*

SUCCESSFUL FINE-GRAIN NEGATIVE PROCESSING, third printing, is an informative little handbook presenting a complete explanation of the process of fine-grain developing, stripped of technicalities. Included are detailed instructions for the actual development of an exposed roll of film *Service Department, Raygram Corp., 425 Fourth Avenue, New York, N Y.—5 cents.*

TRANSPORTATION PROGRESS, by Arthur Pound, is a 52-page reprint from "The Turning Wheel." It traces the history of self-propelled vehicles from earliest times down to the modern motor car. Included are a number of interesting drawings of ancient vehicles. An appendix lists milestones in transportation. *General Motors Corporation, Detroit, Michigan.—Gratis.*

SCREW MACHINE ENGINEERING is a new monthly periodical which should be of interest to all whose work touches in any way upon machine production that involves the use of turret lathes, chucking machines, and other equipment in the screw machine field. *Screw Machine Engineering, 34 West Main Street, Rochester, New York.—Subscription rate on application.*

THERMOCOUPLES is a 40-page catalog of assemblies, parts, and accessories which includes information of general usefulness on the correct choice of couples. Tabulated in easy-to-use form, this information will serve as a guide to the selection of couples for specific applications. Completely illustrated. *Leeds and Northrup Company, 4934 Stenton Avenue, Philadelphia, Pa.—Gratis.*

ANTI-AIRCRAFT coördination with the air forces of the United States (see page 311) is essential to an adequate aerial defense program. This month's cover illustration shows, foreground, an aircraft range-finder that works in close co-operation with the anti-aircraft guns, background. Photograph by Robert Yarnall Richie, taken at Camp Buchanan, Puerto Rico

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SCIENTIFIC AMERICAN

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NINETY-SIXTH YEAR • ORSON D. MUNN, Editor

DECEMBER • 1940

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PLASMA TO BRITAIN

THE wealth and ingenuity of America face no insurmountable difficulty in rendering enormous aid to the valiant British Well and good! We all do what we can, and our cheers go up as we note with what spirit our kinsmen across the sea make use of the weapons of defense we send them

Some emotion deep within us stirs, however, when we read of a particular gift made, at this writing by some 6000 New Yorkers, to the British cause The weapons we've shipped, defensive though they are, have to do with death while these 6000 donors have given life—something of both body and spirit—for they have given their blood Three thousand quarts of their blood have been processed, put into blood banks for transfusions, and probably much of it has been shipped to England by this time.

It is appropriate to recall here the fact that blood banks were conceived by an American surgeon, Dr. O H Robertson, in France during the World War. A little added sodium citrate prevented healthy blood—drawn from the veins of others—from clotting, and it could be kept in bottles in refrigerators Two to four weeks was its keeping limit, however, and, in transfusions, the patient had to be given a type to match his own The former limitation would give us insufficient time both to collect and then ship refrigerated blood overseas, and the second added the danger that the seriously wounded person might die while his blood was being typed Happily, these limitations no longer exist A research group of the Rockefeller Institute for Medical Research has developed a way to extract from blood both the red and white cells, leaving only the plasma And the plasma which we are now sending to the fighting British will keep for years, and may be transfused into any patient regardless of which of the four blood types he has

Murderers and megalomaniacs may pervert to inhuman use some of the products of science, but here is one that cannot be so perverted It is a life-giver, not a death-dealer The process itself marks a milestone in the advancement of man's knowledge But when so many persons utilize it voluntarily—under no compulsion of patriotism or self-preservation—to render precious aid to a friend, then does our faith in humanity receive a heartening boost —*F D M*

WHOSE FAULT IS IT?

NO ONE today even thinks of asking whether concrete will prove to be permanently acceptable as a material of construction Of course it will It will, despite certain observable faults

For the past weeks the writer has been taking note of each piece of concrete construction, large and small, seen in the course of ordinary life—factory buildings, bridges, railway platforms, sidewalks, posts—not in any special capacity but as anyone having an ordinary interest might observe It turns out that the job which has stood up even for a few seasons without extensive cracks, chunks spalled off, unsightly patchings and other evidences of deterioration, is rather exceptional. What or who is to blame?

Easiest, of course, is to blame the constructor. Maybe he cheated. Probably he lacked pride of workmanship Perhaps he was ignorant of best methods, though ignorance about concrete is less common today among its users than it once was, thanks to years of instructional hammering by the Portland Cement Association and others

Economics and machinery have exerted an interesting kind of control over concrete for the past half century, divisible into three periods: First, in the last century most of the cement used was imported from Europe and was expensive, but labor was cheap. It paid, therefore, to mix the concrete stiff, with just enough water to wet it barely, which in turn required laboriously ramming the non-flowing mix into place by hand Such concrete has maximum strength Some of these old jobs are still giving fine service

The second period came with relatively cheap American-made cement but expensive labor Stiff mix and hand ramming then passed out and most work was poured—too much of it at the water-weakened consistency of soup Much of that work deteriorated

Today we are in the third period Cement still inexpensive, labor quite high but better methods available for placing less soupy, hence stronger, concrete, also, vibrating machinery is available for ramming it inexpensively Much better work is being done but, even so, much of it soon looks mangy

It is believed that if the ultimate people, largely the public, who pay for concrete work and not merely the engineer, clearly understood only a few basic facts about it, higher standards of workmanship would result, since these can be attained wherever they are appreciated, demanded, and willingly paid for The cleanness of the materials is not, as is so commonly believed, the most important factor in obtaining sound, strong concrete, though it still is very important There are two other big factors One is the amount of water used—the more water the less ultimate strength, in a ratio as great as three to one between stiff and soupy mixing This of course takes more time and costs more money. The other is curing, something too often dispensed with altogether After the concrete has set enough to prevent it from washing away, the surface is kept wet for some days, preventing the escape of the correctly proportioned amount of water needed within to combine chemically and permanently with the cement.

Concrete is a coarse material but it pays to be fussy with it.

These points may seem elementary to engineers, yet, when it is realized that there still are many persons in other lines of work who think the setting of concrete consists of drying it out, they may not be altogether out of place.—*A. G I*

50 Years Ago in . . .

(Condensed From Issues of December, 1890)

DEFENSE—"It has for many years been patent to every one that New York City, with the great industrial forces and vast aggregate of wealth concentrated around what is known as the Port of New York, are entirely without defense against such an attack as might be made by the vessels of any first class power with but a few hours'

notice A plan quite unlike anything heretofore attempted anywhere for the construction of forts for the defense of the ocean approach to the city has been brought forward by Mr John F. Anderson, a New York engineer, and consists in the construction, on artificial islands, of three forts, each with a diameter of 500 feet, between Rockaway Beach, on the Long Island shore, and Sandy Hook point . They would be about two miles apart, and the same distance from each shore, so as to command all the channels of approach, while being from twelve to fifteen miles distant from the city "

PIGEONS—"Efforts are now being made to introduce a carrier pigeon service into the United States Navy War vessels employed in defending a coast are often without the means of transmitting information of the utmost importance to the mainland By means of carrier pigeons they could send communications ashore over a distance of several hundred miles, signal the approach of the enemy's fleet, and report all his movements "

FIRELESS LOCOMOTIVE—"A fireless locomotive for use in mines is provided with a tank that holds 0.550 cubic meter The water is heated to 205° C. (or an absolute tension of 16 atmospheres) by a boiler placed on the surface, it is sufficient for a steady run of 3 to 4 kilometers "

ROPE—"Ropes sometimes wear out internally while apparently sound outside This is caused by bending the rope over a sheave In doing this the fibers slide a small distance upon each other and eventually wear out In the best ropes this wearing out is prevented by lubricating the strand with plumbago, mixed with a small quantity of tallow, just sufficient to hold it in place "

LOG RAILS—"Mr Angus McPherson of Cumberland County, Nova Scotia, has built 1¼ miles of railway into his lumber woods this summer and is now running a train on it. The rails he used are round spruce poles, six inches in diameter at the larger end, tapering down to half the size, and neatly joined at the ends. The sleepers are small round poles on which the rails are spiked. The rolling stock consists of a small upright engine, eight horse power, and two flat cars "

METER—"A new penny-in-the-slot contrivance has been adopted by the gas department of the corporation of Birmingham, for the benefit of small consumers. . A sort of meter has been constructed, which, on dropping a penny in a slot, will deliver twenty-five cubic feet of gas "

BRIDGE—"The great steel bridge across the Columbia River, at Vancouver . will be 6,000 feet from the Washington to the Oregon shore. It will be double tracked, with a roadway on top for teams, and will be erected upon pneumatic piers The pivoted pier, or draw pier, will support a draw which will give an opening of 200 feet space on either side for vessels to pass, and the span immediately south of the draw span will be 375 feet."

PATENT CENTENNIAL—"The wealth and economic prosperity of our country are so largely due to the system of patents, by which our inventors have been encouraged to pursue their unselfish labors, that among the many centennials which have been and are to be commemorated, the one hundredth anniversary of our patent system should not be overlooked "

BIG GUNS—"The chief of the bureau of ordnance, Gen S V Benet, in his . annual report, notes that a twelve-inch breech-loading steel rifle is now nearing completion at the Watervliet Arsenal, and will probably be ready for trial in February This is the largest size of modern gun we have yet attempted to manufacture, but the Watervliet plant is being put in shape by the government to turn out, also, sixteen-inch steel guns. These guns will be fifty feet long and weigh 125 tons each, requiring a full firing charge of 1,000 pounds of powder . and throwing a projectile over a ton in weight It is expected that these guns will have a maximum range of about fifteen miles."

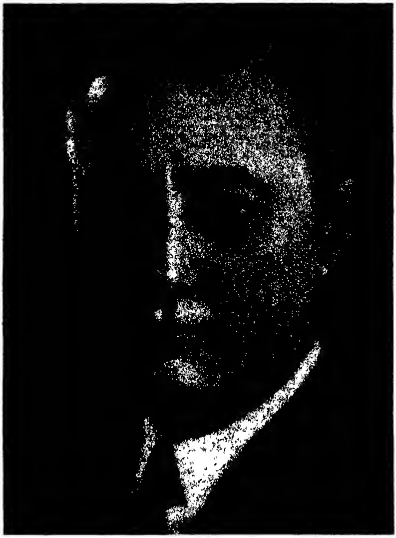
CHIMES—"Dr Alva Owens, of Chicago, recently constructed a set of chimes to be rung by electricity . Attached to each of the thirty bells hung on the rack above the key-board is an electro-magnet. The keys make the circuit from a battery in the base to the electro-magnets at the bells "

STEEL—"The Otis Steel Company, of Cleveland, which has the largest plate mill in the world, a few days ago rolled a 20 inch ingot of 8,500 pounds down to three-quarter inch plate with one heat."

BUILDING—"The new Masonic building now being erected in Chicago will be an architectural marvel. It is to have a frontage of 170 feet, a depth of 114 feet, and will be twenty stories high, and the roof will be nearly 300 feet from the level of the street. There are to be eighteen elevators, arranged in a semi-circle, having a total carrying capacity of 40,000 passengers daily."

SMOKELESS—"The basis of all the new kinds of smokeless gun-powder is cotton subjected to the action of nitric acid and the consequent formation of mono-, bi-, and tri-nitrocellulose according to the strength of acid employed. . . This new powder is said to be on the average three times as powerful as the old."

Personalities in Industry



MARTIN L. DAVEY

Long before the poet wrote of trees, Martin L. Davey knew that they were creations to cherish —living things and, as such, amenable to curative processes That knowledge led to the founding of an organization devoted to scientific shade-tree care that now does a business of nearly $3,000,000 annually

Martin L Davey was born July 25, 1884 in a small, rude home built with his father's own hands in Kent, Ohio Young Martin started on his business career when he was six years old by peddling vegetables gathered from his father's truck garden All through elementary school, he added to the family income and later financed his way through high school.

Martin had an exceptional father, John Davey, who has been called the "Father of Tree Surgery" His book, "The Tree Doctor," published in 1901, laid the foundation for the science of shade-tree care and awakened people to the fact that tree life could be preserved, nurtured, and maintained in healthy condition for the enjoyment of everyone John Davey, the father, was something of a dreamer and idealist, and needed just the executive and administrative ability early displayed by his son, Martin During Easter vacation in 1906, young Martin decided to join forces with his father, and left Oberlin College. At 22, he organized his father's affairs into an incorporated company and became general manager He now is president of the Davey Tree Expert Company

Though not a scientist, Mr Davey has surrounded himself with a group of outstanding technical men. There has been constant improvement in technique, materials, and equipment. The moving of large trees has been one conspicuous development. Fifteen years ago, big trees were being moved on contraptions that resembled Spanish-American War artillery wagons. The Davey staff redesigned the equipment, using all modern aids to make it highly efficient special metals added strength and reduced weights, a change was made from iron to pneumatic tires which cut into the ground less and have advantages of speed, the general mechanism was improved so that trees could be more readily and safely handled A practical injection method for the successful treatment of chlorotic trees was developed, and, currently, injection experiments are being conducted with a view toward controlling serious tree diseases

The battles Martin L Davey has fought in behalf of shade-tree preservation have been waged not only for his own company, but indirectly for all other organizations in the same field, for his theme has always been "Better and healthier trees kept in good condition by qualified experts" To give the best service to the public, Martin L Davey started the Davey Institute of Tree Service in 1909 In its first year the school had a few students meeting in a hall over a store but developed into a three-winter course with a peak attendance of 447 employees Most of the company's thousand field men and its 70 sales representatives are graduates of the school

The company had little capital in its early days, no one cared to invest in such a "fool" enterprise as taking care of trees There were scoffers aplenty but Martin L. Davey's faith in his father's ideas and in his own ability to translate them into actual practice for the benefit of tree life, admitted of no failure

Politically, too, Martin L Davey has had a successful career At the age of 29 he was elected mayor of Kent, was twice re-elected, and at 34, while serving his third term, was appointed to fill the unexpired term of the Congressman for the 14th District of Ohio who had died in office Twice nominated for Governor of Ohio, Martin L Davey was elected on the second occasion in 1934 and was re-elected in 1936.

EIGHT STREAMS OF METAL STINGS

MANY times the British Spitfire has proved itself the deadliest fighter plane in general use during the present war. In this drawing, showing the plane cut away so that its equipment is visible, a Heinkel bomber is being slashed to pieces by a withering stream of bullets from the Spitfire's eight Browning (American) machine guns Empty cartridges and links of the cartridge belts (which disintegrate on firing) stream behind from 160 shots per second. All eight guns are fired together by simple pressure of the pilot's thumb on a button on the "stick." Smaller, lighter, and slightly less maneuverable than the Hurricane, the Spitfire has a speed of 395 miles per hour Some Spitfires have been mounted with shell guns, and all now have partial armor protection for pilots and tanks, such protection having been found on no crashed German planes. Super versions of both Spitfires and Hurricanes have recently been produced.

96TH YEAR SCIENTIFIC AMERICAN DECEMBER 1940

AIRPOWER FOR DEFENSE

Strategic Requirements of Aircraft in All Services

JAMES L. H. PECK

THE United States has been forced by world conditions to assume the defense of what is, to all strategic intents and purposes, half of the world This involves the maintenance of strategic security of North and South America and, roughly speaking, the western half of the Atlantic and the eastern half of the Pacific—a tremendous task which even a two-ocean Navy and a 1,200,000-man Army could not accomplish without the aid of that greatest of modern weapons—airpower

Our airpower is not made manifest by an independent air force, but by the Army Air Corps and the Naval Air Service, each of which employs particular types of planes that are best suited to naval and army operations The Navy is immediately concerned with the control of the above-mentioned sea areas, it is our "first line of defense " Without such control, American commerce could be blockaded from points far removed from the coasts and beyond the range of shore-based aircraft Our insular possessions, or those of friendly powers, could be occupied and used as enemy advance bases against us, and this could be followed up by the establishment of hemisphere bases from which the United States could be attacked by airpower assault and sea power "investment " Fortunately, the Navy in general and its air arm in particular are in a position to exercise control, in that they have immediate access to information concerning enemy activity in these sea areas and also the power to reduce such activity. Thus, the strategic requirements for our Naval Air Service craft are the ability to gain enemy information and the flexibility and striking power to counteract hostile operations

The first assignment is delegated to the "big boats" — the huge, multi-motored flying boats known as patrol bombers—and the scouting squadrons of the Fleet's aircraft carriers The Consolidated PB2Y-2 boats, 18 of which will shortly go into service to form a new patrol squadron, are our best type Powered by four radial air-

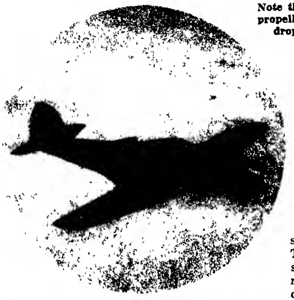
NATIONAL DEFENSE

cooled motors, they have a range of more than 5000 miles carrying a nine-man crew and several tons of bombs Their famous predecessor type, the Consolidated PBY boat, is the present first-line patrol bomber and has a range exceeding 3000 miles Operating from the recently acquired Atlantic bases and those in Alaska and the Pacific, these long-range craft can effectively patrol our "half" of each ocean On mission, the squadron planes fly in a fanned-out scouting line miles out of sight of each other but in a precise line maintained by radio contact and exact navigation Even so small a number of craft can, in this manner, cover a remarkable amount of territory; they are in truth the "eyes of the fleet."

Not so far-sighted are those "eyes" represented by the carrier-based scouting squadrons, whose main purpose is to spy out advance units of the enemy fleet—submarines and cruisers or aircraft The carrier's main function, however, is the fulfillment of the second Navy requirement—striking power, or the delivery of firepower —and to this end our floating airports accommodate Douglas TBD-1 torpedo bombers and Northrop BT-2 dive bombers (Both scout bombers and patrol bombers live up to the second part of their designations once they spot the enemy, the big boats bombing from level keel at high altitudes while the scouts get right down to things by dive-bombing tactics) The carrier fighter complement boasts such sterling combat planes as the Grumman F4F3 and the Brewster F2A-2 at present, a quantity of the sensational 450-mile per hour Grumman *Skyrockets* are on order

The seaplanes carried aboard the Fleet's battleships and cruisers are employed for short-range scouting and range-correction, they are sent aloft from catapults, then land alongside to be hoisted aboard by cranes Training planes of various types, and utility craft for the transport of personnel and matériel, are, of course, most essential Marine Corps Aviation is an integral part of the Naval Air Service and operates therewith as well as in support of Marine ground units. It is of daily growing importance because of the apparent necessity of garrisoning both the new Atlantic bases and establishments in Central and South America

WITHIN 100 miles of our coasts, the Army Air Corps takes over, and theirs is the big job of continental air defense, together with that of the Panama Canal Zone Because of our long coastlines and the necessity for close co-operation with our neighbors to the north and south, it is vital that we have a powerful, highly mobile striking force that may, in whole or part, be shifted from one section of the country to another within a few hours Such is the General Head-



Note the 37mm cannon in the propeller hub, and the tear-drop cockpit of this Bell P-39 Airacobra

quarters Air Force, which may best be described as an air force within an air force, since it consists of all the combat squadrons within U S. borders The GHQ Air Force may operate in close support of ground forces in the United States, Canada, or Mexico, in joint Army-Navy operations, or completely independent of land or sea units. Supplementing this roving "big stick," are several Air Corps tactical units in strategic points of the country, in the Canal Zone and the Hawaiian Islands, new establishments are under construction in Alaska and Puerto Rico

BOMBARDMENT is the mission of airpower, the fist of the air arm, even as infantry is the fist of the Army. The Air Corps egg-layers are divided into three groups: Heavy Bombardment, Medium Bombardment, and Attack Bombardment The former include the "flying fortresses"—so-called because of the amount and disposition of their defensive armament—that are capable of carrying huge loads of bombs for great distances Outstanding of these are the four-engined Consolidated B-24's which have a range of some 3000 miles with a nine-ton bomb load On shorter missions, with less war load, they have a top speed in excess of 370 miles per hour, and climb to the pursuit-ship altitude of 36,000 feet Planes of the Medium Bombardment group are smaller, faster, and operate over shorter distances The twin-engined Douglas B-23 and the 400-mile per hour North American B-25 are the newest types. Attack bombers engage in short missions involving strafing and dive-bombing of troops and stationary objectives. Twin-engined types such as the almost-400-mile Douglas A-20A carry fairly large quantities of bombs and armament; single-motored craft such as the Vultee YA-19 and Republic *Guardsman* do the dive bombing

Reconnaissance aviation is charged with the maintenance of strategic security over land, just as the scouting force guards against surprise at sea. Due to developments in Europe, the Air Corps has discontinued use of the observation plane of medium range, as is evidenced by the lack of orders for the robin-breasted North American 0-47 series, the finest line of planes of this type ever built by any country. For distant reconnaissance, it seems safer to send the heavier - armed bomber, most of which have provisions for installation of aerial cameras anyhow Liaison missions—the purpose of which is to maintain contact with ground units, keep the divisional command informed as to his advance force's location, progress, and requirements, and "warn" these units of enemy movements which might jeopardize them—and artillery "spotting" are best carried out by relatively slow craft or autogiros that can land on a roadway or nearby cow pasture during operations in the field. Latest and best of these "puddle jumpers" are the Ryan YO-51, the Stinson O-49, and Curtiss O-48, all high-wing monoplanes powered by radial engines

Pursuit is the Air Corps' fighting force, and our combat planes are known as pursuit-interceptors and convoy fighters The former types would go up to engage enemy bombers or observation craft in defense of a city or area and the convoy fighters would accompany bombers or reconnaissance planes on a mission in order to protect them against enemy pursuit. By the time this is in print, the Air Corps will have taken delivery on quantities of Curtiss P-40's, Bell P-39 *Airacobras*, Bell SM-1 *Airacudas*, and Lockheed P-38's. The first two are single-engined ships, while the SM-1 and P-38 are powered by twin Allison motors.

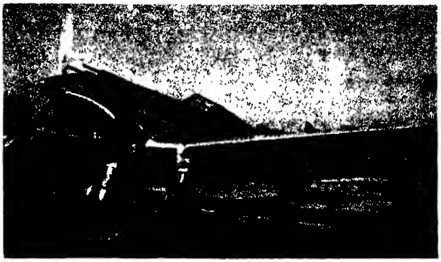
These Navy and Army aircraft are by far the finest in the world, but there are all too few of them. There are not enough pilots and ground personnel to fly and maintain the 25,000 Army and 10,000 Navy planes we hope to have by the end of the next fiscal year; nor are there adequate bases and airdromes on which to put them. Thus, the United States is concerned at the moment with the procurement of planes, engines, accessories and spares, and armament; pilots and combat crews—gunner-observers, bombardiers, navigators, and radiomen, mechanics, radio technicians, sheet metal workers and welders, armorers, parachute riggers, meteorologists, flight surgeons, and technicians and specialists of a dozen other callings—all of which are a pre-requisite of airpower The

Planes and anti-aircraft must be coord

airport program is at last under way.

We have mentioned the different types of craft used by both services to conform with the defense requirements of the Army and Navy Fighters fight, and bombers bomb; but our warplanes are of diverse design and construction because of the difference in specifications and operating conditions. There are reasons, remediable and otherwise, why the services cannot seem to agree on a few basic designs Standardization would, of course, greatly expedite production, and to this end the Aeronautical Board—a liaison agency headed by the chiefs of the Air Corps and Naval Air Service—is seeking to coordinate production methods, machine practice, aero research, and exchange of technical information The principal difficulty arises from the "extras" which Navy planes must incorporate—"flotation gear", specially treated, corrosion-resisting alloys, special radio equipment, nautical instruments and signalling devices, and personal essentials such as life jackets and emergency rations

Carrier-borne aircraft are stressed to withstand the rigors of deck landings and arresting gear and the recoil shock of gunfire These are "musts " An Army plane not so stressed, and unprotected against the deteriorating effect of salt water and spray would fall apart after a few months' carrier operations Not so apparent are the reasons for different kinds of bolts and nuts on an otherwise identical pair of Wright Cyclone motors (differing hardware specifications), two inspection and testing routines, and separate sets of reamers, dies, collets, and so on for tooling As if the machine-tooling bottleneck were not tight enough on general principles!



Powered by a 1200-horsepower Allison liquid-cooled engine, "several per day" of these Sterling-Curtiss P-40's are rolling off the production line

…ed. This gun fires 85 shells per minute

SOMEWHAT less of a problem, but requiring more time per unit, is the training of air personnel A swift fighter may be built in seven days; an embryo pilot must have that many months of training before he can safely fly this tricky, hot-to-handle ship. The Air Corps is well started on an ambitious program involving the training of 7000 pilots and 3000 bombardiers and navigators annually. Primary instruction will be continued at the nine Army-supervised commercial flying schools, some of which are opening branch schools to accommodate increasing quotas. Then aviation cadets will be sent to one of the three training centers for basic training, advanced and specialization work. Randolph Field, San Antonio, Texas, long known as the "West Point of the Air," is now called the Gulf Training Center, Maxwell Field, Montgomery, Alabama, formerly the home of the Air Corps Tactical School, is known as the Southeast Training Center; and the West Coast Center is located at Moffett Field, California Cadets spend 10 weeks in the civilian school and 25 weeks at the training center, after which time they are sent to tactical units for active duty

Navigators undergo three weeks of "elimination training" at one of the Naval Reserve Aviation Bases before they are sent to the Naval Air Station at Pensacola, Florida, to complete their aerial education. Because the Navy plans to train 10,000 pilots within the next two years, three air stations are under construction at Jacksonville and Opa-Locka, Florida, and Corpus Christi, Texas. Enlisted personnel and technicians receive their schooling at the Naval Establishment at Pensacola.

Air Corps mechanics, armorers, parachute riggers, instrument specialists, radio operators, and other enlisted men learn about maintenance of an air force at the Technical Schools at Chanute Field, Rantoul, Illinois, and Lowry Field, Denver, Colorado. Others are enrolled in seven Army-supervised civilian schools. These are the warbird's housekeepers The Army's 3000 bombardiers and navigators will be tutored at the Pan American Airways school at Miami

Neither Pan American nor the other airlines will step out of character further, because these carriers must bear the brunt of our stepped-up commerce if, and when, M-Day comes Nearly as busy as the airlines are the service planes of the Utility branch. Cargo planes, transports for officers and enlisted personnel, and ambulance craft ply back and forth between bases and aircraft carriers on their errands of military mission and mercy. Newest of the transports is the Douglas C-47, of which a quantity have been ordered for the new parachute unit undergoing training in New Jersey.

Pratt & Whitney's 1850-horsepower engine. Extended nose facilitates streamlining

This 1940 has indeed been a momentous year, but within the coming year we shall witness even a more rapid march of aerial progress. Aeronautical research, genesis of airpower, in our N A C A laboratories, Naval Aircraft Factory, Wright Field, and that of the aircraft and engine manufacturers, is being extended in the quest of new aerial findings and methods for exploiting them. Most exhaustive of research is the actual war-testing of our various American prototypes, and we have already profited by experience. We have two types of leak-proof fuel tanks which are far superior to anything known to be in service abroad, we have the finest aerial armor plates, automatic shell cannon, and heavy caliber machine guns in the world, we have the only fool-proof bombing sight. America's warplanes, on which these accessories and armaments are being installed, out-perform by far any European War II craft of any type or model, and they are built to higher specifications standards and of materials that are vastly superior.

Anti-aircraft defenses, with which interceptor forces should be coordinated, are likewise improved, particularly the fire-control devices. Newest of these is the detector which utilizes the infra-red radiation given off by airplane engines, and concentrates this diffusion of rays into a visible image on a ground screen. The range-finder and Sperry-Wilson "predictor" automatically ascertain the altitude, speed, and course of the image—enemy plane—and the guns are fired accordingly. Experiments are being conducted with an infra-red ray searchlight, which may later be used in conjunction with this telescope detector. To assist further in aerial defense, the Aircraft Warning Service has been inaugurated to enlist civilian aid in the spotting of enemy planes.

It is highly probable that performance of our craft will be increased more than 10 percent during the coming year. Aerodynamical advances such as the remarkable Davis aerofoil—used to such advantage on the Consolidated B-24 heavy bomber—and engineering innovations should make this possible. The Lockheed P-38 is reported to have attained the long-sought 500-mile per hour mark at this writing, and the limit does not appear to be in sight.

It is not all sunshine, however. Productive industry is slow getting into high gear, perhaps through no particular fault of its own. The machine-tooling bottleneck is still seriously narrow, as is also the aircraft instrument situation. Skilled tradesmen are not plentiful. There is a surprising and unreasonable lack of Army-Navy air coordination, despite the efforts being made in certain quarters to alleviate this condition. There is far too much politics in defense in general and aviation in particular.

But we have surmounted higher obstacles. We inherit certain imponderable qualities with which America alone seems blessed these dark days. Spirit and morale which is inspired by the heart and feeling of a free people—not the sort born of extreme nationalism and propaganda ministries—and the mechanical heritage of the American youth supply him with the finest flying background obtainable, our excellent services furnish him with the finest training obtainable, our industry and engineering genius afford him the finest of equipment. This is the American Way. On land, sea, or in the air, it will be hard to beat.

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RUBBER DIE

Pad Used With Single Forming Die

By using a flat, thick pad of rubber in the fabrication of airplane parts, the Douglas Aircraft Co., Inc., has been able to lower die cost and speed production in line with our needs for national defense. When operating with this rubber pad, only one die is used and tooling methods are simple. The slabs of rubber are the largest pieces ever designed for commercial application by the Goodyear Tire and Rubber Company, weighing approximately 4000 pounds and measuring 160 by 57 by 11 inches. This development was reported in a recent issue of *India Rubber World*.

In application, the rubber is confined within a steel container which descends on a lower press table where many types of dies may be operated simultaneously. When the sheet metal is laid upon the rubber slab and pressure is applied, the rubber conforms to the shape of the dies, thus forming and blanking metal sheets into their desired shapes.

The Guerin process, as it is known, makes possible an exceptionally high strength-weight ratio by forming sheet metal quickly into a rigid structural part, eliminating the need of stiffening members.

DIVE-BOMBER

The United States Navy is testing out a new all-metal Curtiss-Wright dive-bomber, the XSB2C-1. Greater range, increased machine-gun fire, higher speed, heavier bombs, are all claimed for this machine, although beyond a statement that a 1700

Just after bomb release

horsepower double-row Cyclone is to be employed, no details are given. The artist's drawing hints at flaps to retard the dive, wheels completely retracted and drawn up and sideways into the wing, and bomb bays with bombs carried horizontally under the belly of the fuselage.—*A. K.*

NAZIS' POOR "GAS"—Gasoline used to power German airplanes in general is from 70 to 80 octane rating, equivalent to our standard grades of motor fuel, whereas the RAF has aviation grades of gasoline, thus in part accounting for the apparent superiority of the British fighters —*Oil Weekly*

UNBREAKABLE SPECS—Eye-glasses are worn by one football player, Thatcher Longstreth of Princeton These are of the contact lens type —*Visual Digest*

TUNNEL MILEAGE—There are 1539 railroad tunnels in this country with an aggregate length of 320 miles—Notes, Association of American Railroads

WE USE MORE SNUFF—The average person, thinking of snuff-taking as a rather ancient habit, will be surprised to learn that from a little less than 4,000,000 pounds in 1880, production jumped to 41,000,000 pounds in 1929 Nowadays, however, snuff is used generally like chewing tobacco —U S Department of Agriculture

QUIETER CARS—About 400 pounds of rubber, in 1009 rubber parts, are used in the modern streamlined trolley car which is built to the specifications of the President's Conference Committee of the street railway industry —*India Rubber World*, September 1, 1940

GELATIN ENERGY—There is no evidence that gelatin cocktails are harmful in themselves, but it is yet to be scientifically proved that they do us any good —Dr Iago Galdston, in *Hygeia*, October, 1940

LIGHTNING STRIKES TWICE—Lightning struck the Empire State Building at least 20 times during the period between April and October, 1940 Because the building is properly grounded no damage resulted —Notes, General Electric Company

SMALLER THAN BACTERIA—It would take something more than 5,300,000,000,000,000 smallpox viruses to weigh one ounce —Dr Thomas M Rivers, Rockefeller Institute for Medical Research

ACRES OF RAILROADS—Approximately 4,000,000 acres of land, equal to about one sixth of the area of Indiana, are used by the American railroads for rights-of-way, yards, shops, station grounds, and other transportation purposes —Notes, Association of American Railroads

NITRATES—Preliminary results of an experiment at Woollongbar Experiment Farm have shown that, following a short fallow, the nitrate nitrogen content of the soil is considerably increased. Half of the experimental plots were fallowed for about two months, the other half remaining under pasture Analysis at the end of the above period showed that the plots under pasture contained an average of 4.5 parts per million of nitrate nitrogen while the fallowed plots averaged 60 parts per million.—*The Agricultural Gazette of New South Wales*

HIGHEST TEMPERATURE—The highest man-made temperature on record—18,000 degrees, Fahrenheit—has been produced by Dr. C. Guy Suits This is twice the temperature of the Sun's surface.—Notes, General Electric Company.

PHYSICALLY UNFIT—Approximately one third of the men examined for World War service, reports Dr. W S Leathers of Vanderbilt University School of Medicine, were physically unfit for military duty —*Science Service*, October 8, 1940.

HELIUM—More than 100,000,000 cubic feet of helium have been produced at the U S government's plant, only one in the world, in 11 years of operation That quantity is sufficient to inflate nearly 20 monster airships, such as the ill-fated *Macon* and *Akron* —Science Service

FAST WINGS—Hummingbirds' wings beat 75 times a second in flying and 55 times a second when the bird is hovering The bird's flight reaches a speed of nearly 50 miles an hour —Dr Winsor M Tyler, Smithsonian Institution

RESEARCH PAYS—A survey made by Dr Karl Compton, Chairman of the Advisory Committee on Scientific Research of the National Association of Manufacturers, showed that out of 188 companies covered in the survey, 10 companies spend more than 10 percent of their gross income on research, while the average spent is about 2 percent Leaders in research at the present time are manufacturers in the aviation industry —*Journal of Applied Physics*, September, 1940

1000 WELLS PER MONTH—More than 1000 wells are drilled each month in the United States in seeking oil These are from a few hundred feet to more than two miles deep and run in cost up to $250,000 —*Oil and Gas Journal*

TONS OF DUST—Dust storms carry tremendous amounts of material It has been calculated that during some of these storms 126,000 tons of dust per cubic mile of air is lifted and carried by the wind —Blackwelder and Barrows "Elements Of Geology"

RAYON TIRES—Rayon cord tires have given as much as 30 times the mileage of ordinary cotton cord tires in special tests under extreme conditions In one overloaded, high-speed run in a hot country, rayon tires lasted 80,000 miles while ordinary tires wore out in 3000 —William H Bradshaw, E. I Du Pont de Nemours & Company, Inc

INCUBATION—Both the Egyptians and the Chinese knew how to hatch chicks artificially more than two thousand years ago, using crude equipment and laborious methods —Clip Sheet No 1158, U S Department of Agriculture

SILVER STERILIZES—Silver as a sterilizing agent for drinking water may be used in the ratio of one part of silver in 10 to 20 million parts of water to render the water safe for human consumption. The cost would be but $2 to $4 per million gallons of water —Dr Alexander Goetz, California Institute of Technology.

FOREST RED—Green fields and forests emit a ghostly red light. Though this is invisible to human eyes except with special instruments, it is of fundamental significance in the study of the basic physical process of life on earth.—Drs. E. D. McAlister and Jack Myers, Smithsonian Institution

Government-Made Addicts

The Federal Alcohol Administration Still Follows an Ancient Tradition — Blindly

YANDELL HENDERSON, Ph.D.
Professor of Applied Physiology at Yale University

In the United States now the number of alcoholic addicts—the men each of whom consumes a quart bottle of whiskey, or more, every day—is quite constant, and quite constant, also, so far as can be estimated, is the number in each of our 48 states In each the number of new addicts produced each year balances closely the number that die. In nearly every one of the 48 the system of liquor control differs in some details from that of every other state Yet these 48 supposedly differing experiments produce no appreciable differences in results Evidently, then, there is some fundamental factor that is the same in all these experiments, and that dominates the results in all some factor that prevails throughout the entire nation, and reduces all the 48 experiments to one That factor is the high "proof," or alcoholic content, of our distilled spirits, chiefly whiskey, which is the same throughout the nation The Federal government alone controls that factor.

Under Prohibition even the weakest liquors were forbidden Under the system to which we have reverted, and which is now maintained by the Federal government, distilled liquors of low or even moderate strength are virtually prohibited and only those of high alcoholic content are permitted to be labeled and sold as whiskey and other distilled liquors The underlying idea is that it is the duty of the United States government, through its supervision of interstate commerce, to guarantee the quality and quantity of all foods and drugs. It is held that the American citizen should receive full value for his money, whether he spends it for a can of tomatoes, a bottle of medicine, or a bottle of whiskey Accordingly, we have not only the Federal Food and Drugs Administration, but also the Federal Alcohol Administration; and under the regulations which this Administration is authorized to make and enforce, no liquor of a strength below 80 proof—or 40 percent of alcohol by volume—can be labeled or sold in the United States as whiskey, gin, rum, or brandy In 48 states all kinds of experiments and efforts in endless variety are made to ameliorate what Lloyd George, its greatest ameliorator in England, called the "drink trouble;" and all are effectively counteracted by the Federal government, by its maintenance of this high proof requirement.

How this condition came about is briefly as follows. In Colonial days our ancestors on the Atlantic Coast drank rum made from East Indian sugar or molasses But, when they moved west of the Allegheny Mountains, the difficulty and expense of transportation promoted the development of a local distilling industry that made use of grain—chiefly Indian corn. When President Washington appointed Alexander Hamilton as the first Secretary of the Treasury, and Hamilton began to repair the almost bankrupt treasury, he looked about for sources of federal revenue He established a tariff on imports and by act of Congress laid a tax of 10 cents a gallon on whiskey Thereupon the Whiskey Rebellion broke out in western Pennsylvania; and President Washington used the armed forces of the Government for the first time under the Constitution to suppress it.

The excise men then collected a part of the tax, but the distillers evaded a part Alcohol costs little to make; but water is still cheaper, and two gallons of whiskey were easily diluted to three. There were few chemists to analyze the liquor and determine its concentration of alcohol. It was sufficient as a test of alcoholic content to moisten gun powder with the liquor, and try to light it. If the content of alcohol was high enough, and the content of water low enough, to permit the powder to burn, that was "proof," or "100 proof." If the moist powder would not burn, the liquor was "below proof."

To meet this practice, the Government applied a measure that stopped the loss of revenue due to watering, and made 100-proof whiskey—that is 50 percent of alcohol by volume—the standard American liquor. It thereby did more than any other factor in American life to maintain for 150 years a steady production and reproduction of alcoholic addicts. The law specified the same tax "on each proof gallon or wine gallon below proof." The distiller could dilute his liquor, but if he did he must pay the same tax on the water that he added to the barrel that he did on the original contents of the barrel.

Now the term "wine gallon" has nothing to do with wine. The first distillate from a primitive pot still was a liquor low in alcohol and was called "low wines" It was redistilled to produce a liquor higher in alcohol and called "high wines." Hence the expressions "wine gallon" and "proof gallon," which are both just a gallon in volume, but of different alcoholic content, and hence the practice of the Government of basing the federal excise on the "proof gallon" and taxing a "wine gallon" at the same rate, which has served effectively—and unfortunately—to hold American liquor up to high degrees of proof ever since. Even when it was allowed that, after the tax was paid, the liquor might be diluted to 80 proof—40 percent of alcohol—the idea persisted in the popular mind that whiskey, to be whiskey, must be of high proof—as it is to the present day.

History records several cases in which entire nations have within a few years developed a wide-spread addiction to extreme degrees of alcoholism. In all such cases the cause has been the introduction into popular consumption of high proof spirits with low taxes, or none. This occurred in England in the reign of Queen Anne. England was at war with France, and was allied with Holland So French wines were so far as possible excluded, and "Hollands," or gin, was favored as a sign of patriotism. Even when a low tax was imposed, it was largely evaded by smuggling. As a result, habitual drunkenness be-

came appallingly general. The cause and condition were shown by a popular sign on an inn in a poor district: "Drunk for a penny; dead drunk for two pence; clean straw" (in which to sleep it off) "for nothing." And generations of higher taxation and strict control only gradually overcame the general intemperance of the English people: indeed, it lasted down to the War of 1914-1918.

If a low price and high alcoholic content tend to promote intemperance, there is equally strong evidence that high price and lower alcoholic content tend strongly to decrease intemperance. Lloyd-George, as Minister of Munitions, in 1915 found that heavy drinking by the workers interfered with the production of munitions. Accordingly, by act of Parliament, the distillers were allowed to dilute spirits much more than ever before; and the taxes were adjusted so as to make it profitable for them to do so As an outcome, "The weekly average of convictions for drunkenness in England and Wales, which in 1913 were 3482, had, by the first part of 1917, fallen to 929." And the same general policy has been continued ever since, with the result, as Lloyd-George reports in his Memoirs and others confirm, "Britain today is a much more sober country than it has ever been in my memory." Government reports show that convictions for drunkenness per 10,000 of the population in 1938 were only 23 percent of those in 1913.

In recent years the tax on liquor for consumption in England has been about $13 per American proof gallon: contrasting with about $3 a gallon for federal and state taxes together in this country. But this high British tax has been compensated to some extent for both producer and consumer by the allowance of a degree of dilution that makes "Scotch" in England a milder drink than "Scotch" in America, where it must meet our taxes and required concentration. Under the British taxes and concentration the distillers make a satisfactory profit; the consumers are satisfied with their distinctly milder liquor; and the American visitor, finding that he can drink more than at home without serious effects, concludes that "it must be the climate." The benefit is further enhanced by the fact that "Scotch" is always further diluted with "soda" by the drinkers; it is almost never drunk "straight," as is often the case with those in America—especially automobilists—who drink American whiskey direct from the bottle.

Courtesy Calvert Distillers Corporation

Today, alcohol concentration in whiskies is proofed with a hydrometer as it leaves the still, not with gun powder

Thus in Britain a high tax rate and a large legal degree of dilution have made it to the interest of the distilling trade to decrease the intoxicating quality of their product and thereby to decrease to a more than proportional extent the evils associated with it. In America, on the contrary, the system has always been one of low taxes, cheap liquor, and high alcoholic content· a system under which the distilling industry has found little incentive to develop a market for lower proof liquors Yet it is quite certain that, until the federal government adjusts its taxes upward and the permissible degree of concentration downward, so that it will be to the financial advantage of the industry to offer and advertise lower proof liquors at prices that will contrast favorably per gram of alcohol with those of higher proof, the production of alcoholic addicts and other evils will not be lessened: no matter what the 48 states may do.

Even this is not the whole story of American maladjustment in liquor control. There is another important item· the bootlegger One of the arguments adduced in support of low taxes on proof spirits is that higher taxes have always tended to promote the manufacture and sale of illicit liquor The government needs all the revenue it can get from the excise on spirits. It makes strenuous efforts to discover and suppress the moonshiner, the bootlegger, and the smuggler. Yet, at the same time, by its unwise system, it has promoted the very conditions that it wishes to suppress It habitually penalizes the legal liquor industry in its competition with the bootleggers. It forbids the legal manufacturer and dealer to sell any liquor below 80 proof, while the illicit manufacturer and dealer can, and does, dilute his liquor to any extent that his market will tolerate, which is commonly between 60 and 70 proof: rarely higher. And the fact that illicit liquor is commonly diluted to 70 or below is decisive evidence that Americans are like Englishmen in that whiskey below 80 proof would be acceptable What 70 proof is on the tongue is shown by comparing our 70 proof bootleg liquor with cocktails, for 35 percent of alcohol, or 70 proof, is the strength of a dry Martini, and this, by the way, is about the highest concentration that can be taken habitually without destroying the mucosa of the stomach No one can fairly complain that he gets "no kick" from a 70 proof drink

Editor's Note: *Professor Henderson's special competence to write on the subject dealt with above arises from the fact that he is an outstanding scientist and that one of his special fields of research long has been the physiological and social aspects of the liquor problem. Others are physiology of the circulation, bio-chemistry of respiration, and pharmacology of gases. He was one of the organizers of the Chemical Warfare Service, is the author of a book on industrial poisons, entitled "Noxious Gases," determined the standard of ventilation for the Holland Tunnels, and was the scientific authority on whose advice Congress legalized 3.2 beer as non-intoxicating under Prohibition.*

For a fuller discussion of the

subject of the above article see a paper by the same author, in the new Quarterly Journal of Studies in Alcohol, *Vol 1, Page 1, Yale University Press, 1940*

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RADIO KNIVES

War Casualties

May Benefit

MEDICAL science has made such great strides since the World War that already we hear of the use of new techniques in the treatment of wounded in the present war Recently, at a meeting of the Military Surgeons of the United States, Col Gustavus H. Blech suggested that American Army Surgeons will in future use radio-knives on army wounded instead of scissors and scalpel This method is particularly advantageous for wounds of the extremities

"I am sure," Col Blech said, "that in the light of recent experience we should not only provide regimental surgeons with adequate surgical equipment but simplify the scheme of organization for field service by having fewer units but those to be staffed and equipped for all surgical operations permissible in the zones of combat "

NERVOUS

Faulty Sugar Chemistry

May Cause Mental Diseases

FAULTY sugar chemistry in the body may be one cause of mental and nervous diseases, Dr G Wilse Robinson, Jr , and Dr Prior Shelton, of Kansas City, Missouri, recently reported in *The Journal of the American Medical Association* Patients on the verge of a nervous or mental breakdown might, therefore, be helped by treatment of such a condition

Signs of sugar disturbance that could be considered diabetes were discovered by these doctors in a high percentage of patients when first admitted to a hospital for mental disease From one third to nearly two thirds of the patients appeared from the tests to have diabetes The patients were suffering from all types of mental and nervous diseases, including alcoholism. Tests on these patients several weeks after they entered the hospital showed normal sugar chemistry in one fourth to one half of the group, although only one patient was given treatment for diabetes.

From their studies, the doctors conclude that faulty handling of sugars and starches is common in nervous and mental patients and that it may be a cause of the abnormal nervous and mental condition

SIDE VISION

Eyesight Measuring Device

Detects Unsafe Motorists

A DEVICE developed by the American Optical Company detects faulty side vision For safe driving, one should be able to see a moving ob-

ject at an angle of 90 degrees while his eyes are looking directly ahead The perimeter instrument shown in our illustration measures accurately the entire field of vision. It also is used in the diagnosis of eye and brain diseases.

PINK ELEPHANTS

So It Wasn't Primarily

The Drinking

ALCOHOL is "not the principal factor in the production of delirium tremens," three Providence, R I., physicians, Dr. Hugh E. Kiene, Dr. Robert J. Streitwieser, and Dr. Himon Miller, seem to have proved in experiments reported in *The Journal of the American Medical Association*, as reported by *Science Service*

Vitamin B_1 banished the pink elephants in short order, twice as fast as usual, even though the patients in their experiment continued to drink a quart of whisky daily. These five patients were seeing every animal in the Barnum and Bailey outfit, according to one of them, when admitted to the hospital They recovered, on the average, in 2 4 days on a treatment of large doses of vitamin B_1, plus a drink of four ounces of bonded rye whisky every three hours, day and night.

Signs of kidney irritation in two of the patients disappeared within three days under the vitamin treatment, even though the patients were continuing their daily quart of whisky—from which the physicians concluded that vitamin B_1 acted directly on the kidneys in such a way as to indicate probable curative powers

The fact that recovery from acute symptoms of delirium tremens occurred practically twice as fast when vitamin B_1 was injected into the patients' veins, even in the presence of continuous drinking, indicates, the Providence physicians state, that the cause of the condition is primarily a deficiency of the vitamin in the presence of a deranged sugar-starch chemistry in the body

Reason for the vitamin deficiency which brings on the pink elephants is the fact that the person who gets delirium tremens has a habit of failing to "stop for adequate dietary foods in his alcoholic meanderings after the first 12 hours "

PROMISE

New Synthetic Cleansing Agents

Threaten Germs

DISCOVERY of the germ-stopping power of modern synthetic soaps and shampoos may provide scientists with a new class of chemical weapons against disease, including tooth decay, according to *Science Service* Experiments in this direction are now under way at the University of Chicago, by Dr Benjamin F Miller and Dr. Zelma Baker

Three of the cleansing agents, with the trade names Damol, Emulsol-605, and Emulsol-606, are relatively non-poisonous and non-irritating to mice and rabbits They stop the growth of germs in the test tube Their protective action towards experimentally induced germ diseases is now being investigated.

One of the cleansing compounds, Zephiran, is being tried as an anti-tooth decay weapon The germ-

killing power of this substance was announced by Prof. G Domagk, of Germany, the man who gave sulfanilamide to the world. Trials of Zephiran by the Chicago scientists showed that it promises to fight tooth decay in two ways by killing germs and by stopping production of lactic acid which, in high concentration, can destroy tooth enamel and thus give decay a chance to start.

The new cleansing agents were developed to meet various special demands of industry More than 1000 of them have been patented within the past decade They have long, chemical names Zephiran, for example, is alkyl dimethyl benzyl ammonium chloride Another, with the trade name of a much advertised shampoo [Drene —*Ed*] is triethanolamine lauryl sulfate One of them is sulfonated castor oil

RISK

Dangers From Hormones In Some Cosmetics

DANGERS besides the possible development of cancer may result from indiscriminate use of sex hormones and vitamins in cosmetics, Dr Joseph Eller and Shirley Wolff, of New York City, warn in a report in the *Journal of the American Medical Association* Dr Eller and associates point out that a commercial face cream containing a female sex hormone produced cancer in animals as well as other profound changes when applied on the skin in one fifth of the amount recommended for daily use by women

SOFT CORNS

Operation on Toe May Be Needed

A BONE-CUTTING operation for relief of soft corns has been devised by Dr H B Macey, of the Mayo Clinic The anatomy of the fourth and fifth toes make ideal conditions for the development of pressure on a bony prominence which leads to callus formation, Dr. Macey explains Soft corns, situated between the toes, generally between the fourth and fifth, are calluses Their softness arises from their confinement between the toes and the associated moisture of the feet

One of the bones of the fourth toe often ends with a bony prominence or bump pointing toward the fifth toe The opposite bone of this toe may also have a prominence Short, narrow-toed, forward-pitching shoes may cause one if not both of these bony prominences to press on the flesh between, with a callus resulting

To relieve the condition, the prominent portion of the bone of either toe may be removed by operation The prominence must be removed smoothly and cleanly so that no sharp points are left to cause further trouble — *Science Service*

ARCH SUPPORTS

Scientifically Correct, Made of Plastic

LIGHTWEIGHT and sanitary arch supports designed for foot comfort and scientific precision in correcting ailing feet won a major award in the Scientific group of the Fifth Annual Modern Plastics Competition sponsored by *Modern Plastics Magazine*

Designed by S Sydney of the National Foot Appliance Laboratory, New York, these arch supports are made from a plaster of Paris impression of the foot as taken in the practitioner's office of the physician or chiropodist (podiatrist). Sheets of Tenite II are molded by Insulation Manufacturing Company and from these sheets pieces are cut to size. Under heat and pressure they are shaped into supports that are odorless; low conductors of heat; resistant to discoloration, tarnish, stains, and moisture; and that do not warp. Any type of arch support can be made by this method

Plastic arch supports, shaped over plaster of Paris impressions, can be made in any type, or with metatarsal combination

People allergic to steel or leather will find these plastic arch supports to be the solution to their problems of irritation and skin disorders Smooth and pleasant to the touch, the surface will not tear sheer hose

LOWER MORTALITY

From Intestinal Ailment

INTESTINAL obstruction has long been one of the most serious disorders of the digestive organs, with a mortality rate which has remained at approximately 40 percent for more than 50 years Today, however, says Dr William Osler Abbott, of the University of Pennsylvania Medical School, marked success in treating this condition is being achieved through a variety of ingenious new methods, and mortality rates in several large hospitals have fallen to 7½ and 11 percent

SURGICAL RAYS

Ultra-Violet Lamp Aids in Cataract Surgery

HERE'S good news for persons slowly going blind from cataracts. Greater efficiency in cataract surgery has been made possible by the development of a new ultra-violet lamp for use in cataract cases where the diseased lens of the eye has to be removed by operation

The new lamp, developed by the American Optical Company in collaboration with Dr Eliott B Hague, noted eye specialist, is the first one designed exclusively for cataract surgery It provides the greatest source of fluorescing ultra-violet now available for cataract operations, which comprise approximately 25 percent of all eye operations.

The lamp projects a full beam of ultra-violet light of maximum intensity at 3650 Angstrom units Directed into the eye, this light causes the crystalline lens to fluoresce. As a result, the lens becomes brilliantly visible, a distinct help in cataract surgery Furthermore, the lamp insures total extraction of the lens as any remnants, which may later cause trouble, are easily located because of their fluorescence, and extracted.

What Is On Venus?

Newest Evidence Hints Venus is Clothed In Dense Clouds of Polyoxymethelene Hydrates

HENRY NORRIS RUSSELL, Ph.D.

Chairman of the Department of Astronomy and Director of the Observatory at Princeton University Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington

VENUS—the most conspicuous of the planets—is in many ways the most disappointing to the astronomer. The casual visitor to an observatory, enjoying a daytime telescopic view of the planet near the time of its greatest brightness, is likely to exclaim with delight at its brilliance, its whiteness, its crescent phase If he is a little more sophisticated, he may notice the beautiful gradation of light between the limb and the terminator. The experienced planetary observer looks at the same view with something very like despair The surface is white, smooth, and usually altogether featureless, except for the diminution in brightness resulting from the increasing obliquity of incidence of the Sun's rays

Faint and fugitive markings have often been reported by visual observers More contrast is shown on photographs made with ultra-violet light, as Ross showed in 1928, but, even then, the difference in brightness between the lightest and darkest spots is only about 25 percent These markings change radically from one night to the next, and are obviously phenomena belonging to the planet's atmosphere, and not to a permanent surface.

When the planet is very nearly in line between us and the Sun, so that her apparent crescent is reduced to a mere hairline of light, a strange thing happens We might expect this line to extend over a semi-circle, fading out to nothing at the ends, but, when the sky is clear, it has been seen many times to extend over more than a semicircle. This obviously could not happen on a bare spherical body like the Moon. It must be due to twilight—the illuminated atmosphere visible beyond the place where the sunlight grazes the surface itself Indeed, when Venus is within a degree or so of the Sun—which happens rarely—she has been observed on several occasions as a luminous ring—the sunlit atmosphere being in sight all around the dark face.

From the amount of the extension of the horns, it is possible to calculate the height above the planet's surface to which the visible sunlit atmosphere extends, and this comes out only a little more than one mile This is, however, not the full height of the atmosphere, but that of a hazy layer, which is so brightly lighted by the Sun's rays that it can be seen through the brilliantly illuminated foreground of our own atmosphere, close to the Sun.

When Venus can be observed on a dark sky, 20 degrees or so from the Sun, and yet appears as a narrow crescent, we might expect the twilight effects to be more extensive. Something of the sort was recorded by Schroeter, an enthusiastic observer at the end of the 18th Century, and his observations appear never to have been repeated with modern telescopes. Here is a nice problem for an amateur—provided that he has an instrument of considerable size with a field free from scattered light, and lives where the air is, at least sometimes, transparently clear.

THE reflecting power of the surface is high—about 50 percent. When allowance is made for the changing distance from the Earth, it is found that the diminution of brightness with phase, from full to half to crescent, is much smaller than for the Moon. This shows that the surface is relatively smooth. A study by Gerasimovic shows that these two things can be satisfactorily explained if the surface is covered by clouds or fog—consisting (like terrestrial clouds) of particles larger than the wavelength of light, but can not be accounted for by reflection from a solid surface or from a thick layer of cloudless gas.

The rotation period of Venus is still unknown, except that we are sure that it must be long. The markings change so much from night to night that they can not be followed; and observations for radial velocity, which alone suffice to reveal rotation for all the planets from Mars to Neptune, show here only that the motion is too slow to measure It appears certain, however, that Venus does not keep the same side turned permanently toward the Sun. Radiometric measures at Mt. Wilson and Flagstaff show that the dark side of the planet radiates considerable heat; but, if it was always dark, it would be very cold. It is probable that the planet's "day" is several weeks long by our reckoning.

Evidence regarding the composition of the atmosphere can be obtained only with the spectroscope—and our powers of analysis are seriously restricted in the case of a cool body like this We must observe through our own atmosphere —which cuts off all the ultra-violet except a beggarly part near the visible region. All the really strong absorption bands of the familiar gases lie in the inaccessible part of the spectrum For a few of these there are feebly absorbed bands in the observable part of the spectrum, demanding many thousands of times more material to produce than the others, but for many of the best-known gases—for example, hydrogen, nitrogen, carbon monoxide, helium, neon, and argon —there is no accessible absorption at all, and we cannot detect them The exceptions fortunately include just the constituents which are of the most general interest—oxygen, water vapor, and carbon dioxide

The first two of these are present in our own atmosphere, and disturb observations of the planets seriously, but the difficulties, though troublesome, can be surmounted. Venus, with her great surface brightness, is the most favorable of all the planets for such a test. Yet the observations of St. John and Nicholson, at Mt. Wilson, failed to detect any observable absorption by either. For oxygen, the test is sensitive, and the observers conclude that the amount above the surface of Venus must be less than a thousandth part of that in our atmosphere. The test for water vapor is much less delicate, and an

amount much less than a tenth of that on Earth (above a mile-high mountain in dry weather) would have escaped detection.

Carbon dioxide, however, gives bands in the infra-red, discovered by Adams and Dunham, which, though not very strong, indicate that the amount of this gas above the planet's surface is equivalent to a layer about a mile thick, at standard temperature and pressure—about 400 times more than here.

On Earth, however, carbon dioxide is continually being removed from the air by the growth of plants, which use the carbon in building their own substance, and turn back the oxygen. On a lifeless world, we might expect to find far more carbon dioxide, and little or no oxygen, so that this is no puzzle. But the absence of water is hard to account for. The sunlit side of Venus must be hot, especially as the carbon dioxide in the atmosphere must serve as a very efficient heat trap; and it appears probable that the temperature of the planet's visible surface is not far below the boiling point of water, or higher. The solid surface below the visible clouds or haze must be still hotter. If there were oceans on Venus, or any considerable, though smaller, quantity of water, its evaporation would saturate the atmosphere with moisture, and cause the appearance of water-vapor absorptions in the spectrum, much stronger than those produced by the Earth's atmosphere.

Venus is so nearly a twin of the Earth in size and mass that it is very hard to understand how she could have practically no water, while our planet is almost drowned in it. No satisfactory explanation has yet been suggested, yet the train of evidence which has just been sketched is so strong that we appear, at present, to have to accept it as a fact

But if there is no water on Venus—or practically none—what produces the great veil of whitish clouds which covers her whole visible surface? A very interesting suggestion has just been made by Wildt, pointing out possibilities which would never have been thought of by astronomers less familiar with chemistry.

Start with the assumption that the atmosphere of Venus, long ago, contained a great deal of carbon dioxide (it is still there), a small amount of water vapor (for the reasons just stated), and little or no oxygen. The temperature of the surface was, and is, high enough to make the appearance of life very improbable. The surface of the planet, if of composition like terrestrial rocks, would contain partially oxidized (ferrous) compounds of iron, and these, if there was any water present, would undergo weathering and exhaust

A photograph of Venus, made by Harold A. Lower, using a small telescope as a camera. Many are surprised, on their first view of Venus through telescope or opera glass, to discover that its disk is not round but shows phases, as does the Moon. Indeed, there are persons who claim they can even see the half-moon appearance of Venus with the unaided eye (the smallest glass renders the phases clearly visible). Perhaps the fact that such persons know what to look for to some extent influences this belief. Galileo was the first of record, however, to have seen them, using his first telescope. Copernicus had predicted them

from the atmosphere what little oxygen remained, leaving the carbon dioxide and water vapor.

These gases, when exposed to short-wave ultra-violet light, enter into the reaction

$$CO_2 + H_2O = CH_2O + O_2$$

forming formaldehyde and free oxygen. The considerable amount of energy required is furnished by the light

Formaldehyde, while reactive chemically in many ways, is highly resistant to attack by oxygen. Hence it is possible that, while the oxygen is used up by further rock weathering, the atmosphere may contain steadily increasing quantities of formaldehyde gas If so, Venus would be a very poor place for men in some hypothetical "space ship" to land, they would be poisoned at once.

But a test of this hypothesis is available. Formaldehyde exerts a very powerful absorption upon ultra-violet light, producing a system of bands extending up to λ3600 — that is, well into the spectral region which we can observe through our atmosphere Dr. Wildt, during a recent stay at the McDonald Observatory, obtained a series of ultra-violet spectra of Venus, and of the Moon for comparison. Careful comparison of the two showed not the slightest difference in the spectra of the light reflected from the two bodies. If there had been an amount of formaldehyde in Venus' atmosphere enough to make a layer of the gas a quarter of an inch thick, under standard conditions, its absorption could have been observed.

One would think, then, that this theory must be abandoned, but here is where more chemistry comes in Formaldehyde has unsaturated molecules, which have a strong tendency to link themselves up into long chains—indeed, this makes it an important raw material for the production of some commercial plastics Even in the pure state, it condenses into a solid white mass—probably consisting of a complex mess of longer and shorter chains Water-vapor catalyzes the reaction If a small amount of it is injected into absolutely dry formaldehyde gas, the reaction vessel is instantly filled with a dense white cloud of finely divided solid particles If heated hot enough these polymerized hydrates are dissociated into their constituents; but this requires a temperature of about 200 degrees Centigrade At the temperature which probably prevails on Venus' surface, there would be little decomposition—which may account for the absence of the formaldehyde bands in the spectrum

It seems, then, to be quite possible that the very absence of abundant water from the planet's surface—if in presence of abundant carbon dioxide—may lead to the production of white clouds on its atmosphere, and the precipitation of white polymeric compounds on its surface, and so account for its telescopic appearance

Dr. Wildt presents this reasoning tentatively, as a possible explanation. It is very interesting to see how results obtained by chemists, with not the slightest thought of application outside their own science, and published in journals that not one astronomer in a hundred thinks of reading, may, years afterward, offer a clue to an outstanding astronomical puzzle — *Princeton, October 2, 1940*

Protecting Gasoline Tanks

Principles and Practice In Development of Bullet-Proof Tanks for Airplanes

ALEXANDER KLEMIN
Aviation Editor, Scientific American
In charge Daniel Guggenheim School
of Aeronautics, New York University

When the Army Air Corps announced a few months ago that it had secured a leak-proof or bullet-proof gasoline tank, old timers in aviation were astounded—because they had known and used protected tanks at least 15 years ago Protection for tanks was news only to the younger personnel of the Air Corps But if the protection of tanks is an old story, the scientific principles involved may not have been clearly understood hitherto Accordingly, a paper by A R Weyl, in the *Journal of the Royal Aeronautical Society*, entitled "Fire Protection of Petrol Tanks," which does go thoroughly into principles, has been well received on both sides of the ocean The Weyl paper is based on systematic research work with the aid of slow-motion cameras and other devices of modern ballistics

Here are Mr Weyl's general conclusions regarding tank design

The entry hole made by a bullet is harmless, and no ignition is connected with the entry It is quite easy to seal the entry hole made by a bullet The exit hole or leak made by a bullet which has passed through a tank is much larger and is much more difficult to seal The motion of the bullet inside the gasoline produces pressure waves and it is the pressure waves which are the cause of the exit leak and help to produce ignition If the bullet can be made to stop within the tank no ignition may be expected If the bullet can be separated from the gasoline while inside the tank, the exit leak will be small If the bullet can be freed from gasoline at the moment when it is leaving the tank, no ignition should take place Incendiary bullets designed to disintegrate inside a gasoline tank are unlikely to cause ignition

These general principles are of real value but Mr Weyl goes beyond principles and gives some thoroughly practical design suggestions

It is important to concentrate the gasoline of an airplane in one very compact tank Then there is less surface for bullets to strike, and the weight of tank protection is smaller because the compact tank has so much less surface in relation to its volume

What metal should be used? There does not appear much reason to choose one metal over another Brass offers slightly higher resistance to the impact of pressure waves because of its elasticity Magnesium tanks suffer large holes, but their edges are not deformed On the whole, one metal will do almost as well as another

To restrict the pressure waves, it is important to have baffle plates How can the baffle plates be arranged inside the tank so that all likely hits are faced by them? A star-shaped arrangement of baffles seems adequate but heavy

Since pressure waves cause the dangerous exit leak, the tank mounting is important. If the mounting is too soft, resonance is to be feared But above all, the support of the tank must be well distributed, the internal pressure waves are then less likely to cause trouble Further, the tank should not be mounted in brackets, but in a cradle or straps

Is it any help to use hollow containers or compartments within the tank? That might be helpful, since the pressure waves could destroy the internal compartment without the outside walls being affected. Filling of the protective compartments with inert gases was found to be useless, however.

Here, in general, is the proper way to protect the tank Around the metal there is fitted a gasoline-tight fabric, treated skin, or parchment Then a fairly thick layer of sealing compound which swells under the action of gasoline and fills the entry and exit holes. Since the sealing compounds have no strength, a sealing bandage must come outside of all this in the form of highly elastic vulcanized rubber. The compressing rubber cover helps to separate the bullet from the gasoline in accordance with one of the principles given above. The whole structure should be enclosed in a wire net of a large mesh which is electrically connected with other metallic parts of the aircraft to prevent electrical ignition effects.

Of course, superimposed upon all these requirements, will be the final requirement that the protection of the tank must not be so heavy as to impair the general load-carrying capacity of the airplane Otherwise military authorities might decide that it was better to have a lighter, more maneuverable airplane and to take a chance on the bullets piercing the tank

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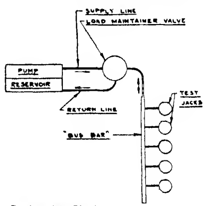
HYDRAULIC TESTING

Destruction of Airplane Parts Reveals Defects

Testing to destruction of the structure of airplanes dates well back in aviation, during the World War the Army Air Service, with the aid of French and British missions, converted into an art what used to be a crude shop test Today, the structural testing of wings and fuselages is as useful as ever, and methods are highly refined

Charles Tilgner, now Chief Aerodynamicist of Grumman Aircraft, has been responsible for great progress in "hydraulic testing" Loading sandbags or shot-bags weighing thousands of pounds on the wing is a painful, slow process, which may be dangerous when the structure suddenly lets go and



Courtesy *Aero Digest*
Diagram of the system of testing airplane parts hydraulically

Using hydraulic jacks to test the structure of a plane wing

heavy bags fly downward. Another drawback of the sand-bag or shot-bag is that if loads are not applied simultaneously, secondary stresses and inaccuracies may be introduced. Mr Tilgner has developed a method which avoids all these drawbacks, loads are applied to the wing by suitably placed hydraulic jacks. The loads from some of the jacks are also applied through a leverage system, so that a single jack applies a predetermined load to various parts of the wing. The jacks are all connected to a single source of supply, as shown in the diagram, and between the pump and the jacks there is introduced a load-maintaining valve in which a weight on top of a piston is used to provide a constant pressure. With pump and valve under complete control, and a single source of pressure supply the engineer can be quite certain that he is applying exactly the required load to each part of the structure. Further, the load can be applied and released with rapidity and ease.—*A K*

AIR TRAILERS

Possibility of Transporting Troops by Air

A CORRESPONDENT asks whether the idea that Germans will tow gliders behind airplanes to transport troops has any merit. In spite of all the discussion by "experts," no definite answer can be given. W. S. Shackleton, writing in *The Aeroplane*, gives as good an analysis of the problems involved as anyone. He believes that such a troop train will be practicable. This would consist of four large gliders, each about 82 feet in span and each carrying 20 troops, spaced 100 yards apart and towed behind a large twin-engined transport.

There are many difficulties, however. The glider train would be slow and vulnerable. It could not possibly defend itself with gun fire, and it certainly could not maneuver or conduct a dog fight in the sky. There is also some doubt as to what would happen to the glider train in rough weather.

We suggest a glider trailer flight as a spectacular feature for the next Soaring Meet at Elmira.—*A K*

SEARCHLIGHTS

IMMENSELY powerful anti-aircraft searchlights of the type being used by the British in defending London are being delivered to the United States Army by General Electric. Naturally, information is restricted, but we are free to say that the lights are 60 inches in diameter and of 800,000,000 candle-power. They are effective for at least $5\frac{1}{2}$ miles in the air, which should be sufficient for spotting most bomber attacks.

The searchlight is not new in principle, since a powerful arc with

800,000,000 candle-power

concentrating mirrors has been customary for decades, but besides the extraordinary power of the new lights it has many valuable features. Thus, the beam may be directed from side to side or tilted up or down just as easily as a motor-car can be steered. Both the lights and the power plants which accompany them are mounted on rubber-tired wheels for easy towing into position or for transportation in trucks. The searchlights are, of course, used with an optical airplane finder. Our photographs illustrate several aspects of these lights. Even though the best anti-aircraft defense lies with interceptors or pursuits, good batteries, well directed, make life very unpleasant for the enemy bombers, these lights should be most valuable in our national defense.—*A K.*

An airplane finder used in conjunction with powerful lights

OXYGEN BOOST

Increases Diesel Power for Take-Off

AIRPLANES require about one third more power in take-off than in flight, and airplane gasoline engines fortunately have higher rating at take-off than in normal operation. Against the airplane Diesel engine there has been raised the objection that its power cannot be boosted during take-off.

Professor P H Schweitzer, of Pennsylvania State College, writing in *Mechanical Engineering*, describes experiments intended to remove this criticism. He has tried to increase the power for short intervals by feeding pure oxygen to the cylinder and increasing the oxygen concentration from the normal 21 percent to 45 percent. So much extra power can be developed for take-off by this method that the size of the airplane Diesel could be reduced some 25 percent by the "boost." While the oxygen containers are heavy, they are not heavy enough to invalidate the possibilities of the system. Now that the laboratory experiments have proved satisfactory, it would be desirable to make an actual test in flight operation.—*A K*

Lightless Light

Black Light—Unseen Rays—Causes Many Materials to Glow, Has Practical Uses

PHILIP H. SMITH

IMAGINE a convoy of ammunition trucks speeding along a highway in pitch darkness, holding to the center of the road and following its contours with unerring accuracy, but using no headlamps This isn't a Jules Verne dream It is a possibility, thanks to black light

If you don't care for the warlike, you can choose a peacetime scene Imagine a motion-picture theater having its lobby illuminated entirely by the soft light of glowing walls and luminous statuettes If you arrive late and the house is dark it is simple to find your seat because a luminous design in the carpet guides you down the aisle, and the seat number sparkles in the dark This, too, is a possibility, and again, it is a black light phenomenon

The paradoxical name "black light" is given to rays or certain wave bands in the ultra-violet end of the spectrum Roughly speaking, these waves have lengths ranging from 3300 to 4000 angstroms (light measure), 4000 being the beginning of visible light These invisible rays have the ability to make certain materials fluoresce, or glow, as though they were producing light They don't tan skin or have germicidal properties as one might expect of ultra-violet rays, these properties being possessed by waves of shorter length Fluorescence occurs only in the presence of the rays It is unlike phosphorescence whereby light is stored and given forth after the light source is removed

Black light is no recent discovery, but it has been used indifferently Luminous costumes have been featured on the stage from time to time Europeans, particularly the Dutch, have developed it to practical ends much more than we have and now the commonplace of blackouts has given it a great boost Today we have available inexpensive black-light sources and a wide color range of paints, dyes, and inks which have been rendered durable through painstaking research

There are three types of black-light lamps The simplest type, suitable for amateur work, is a tungsten filament lamp with a black glass bulb Its life is short because of the high temperatures required for ultra-violet radiation The other types are high-intensity, mercury vapor lamps, one employing a black glass bulb, the other, a clear glass bulb with separate black glass filter This last mentioned type is the most practical and widely used commercially, because the filter does not have to be replaced if the bulb goes Mercury is used because its spectrum contains the richest emission of ultra-violet rays in the black-light zone

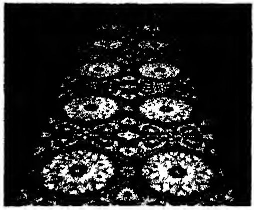
Look directly at a black-ray lamp and if you see anything it is a core glowing like the heating element of an electric toaster. You will notice that a haze comes before your eyes which is annoying but not dangerous. This sensation is caused by a slight fluorescing of the eyeball. If someone should look at you while you are standing in the rays, they would see your teeth glowing in the dark, provided they are your own teeth. Store teeth will not fluoresce Your fingernails also glow, otherwise you would be practically invisible.

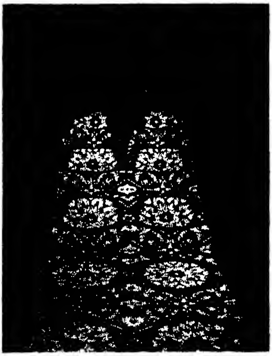
The materials used to make fluorescing paints, dyes, and inks, are more or less trade secrets. There are plenty of substances which fluoresce naturally but it has taken years of experimentation to select them for proper color and durability Today, there is a fair range of colors to be had, and in Europe they go so far as to offer fluorescing materials in the form of plastics, make-up, chalk, and crayons

MOST visitors at the New York World's Fair were unaware that they saw a sort of dress rehearsal of black light The night scene in the Perisphere's miniature city was created by coating windows with a fluorescent paint and turning on black light as the ordinary light was turned off The luminous bathing caps of the swimmers in Billy Rose's Aquacade were simply colored with fluorescent materials so that they would glow in the rays

A possibility for fashion shows: An evening dress and wig under ordinary light and black light. The latter causes the dyed design to glow in colors

At right: **A carpet in a theater aisle as it appears when lights are on, and glowing under invisible ultra-violet rays.** *Below:* **In complete darkness, steps in another aisle are easily seen as black light makes the dyes of the carpet glow**





of concealed lamps. Both these spectacles demonstrated the possibilities for achieving dramatic light and color effects.

Fluorescent wall paints are now in commercial use. Common practice is to paint walls in designs which will look well under all lighting, but glow luminously in desired color combinations under black light and give sufficient light for seeing. It is particularly well suited for the soft lighting of cocktail bars and lobbies. There are paints which show only in daylight; others which respond to both daylight and black light, and a third type which has color only under black light. By a judicious use of these three types in combination, some striking effects can be produced. You'll soon see advertising displays which have a dual aspect created by the alternate flashing of ordinary light and black light. For the time being these will be used indoors or sheltered from direct sunlight because the fluorescent properties are impaired by the sun's rays

As luck would have it, many inexpensive dyes are fluorescent A ten cent handkerchief is very likely to become a thing of rarest beauty in the rays of black light Dyed fabrics can be used for stage curtains and costumes and now there are carpets woven from materials given fluorescence with dyes One wonders what the effect will be upon theater audiences if black light becomes common Fluorescent carpets already are used in 25 theaters Must the theater-goer of the future consider dressing for two lighting effects?

This is a fair question, because the practice of marking fine fabrics with invisible fluorescent inks is being carried on by some laundries and cleaners, and as a result Mrs. Jones is known to have been de-coded as she walked down a theater aisle—late to the performance. If this simple scheme to avoid ugly laundry marks leads to trouble, more can happen. We know that some rouges go dead black under the rays; we have yet to find out about hair dyes

Circulars printed with fluorescent inks are being used to show prospects the possibilities of lighting equipment for advertising purposes. We see a building pictured under ordinary light and that's the daytime appearance; then, by switching on black light, the circular shows signs and building walls glowing with the effect of night reality. It is conceivable that books and magazines will be printed in such inks for those whose eyesight can be helped by illuminated lettering

Black light has moved into the field of fraud detection It can be used to reveal alteration of documents either by showing the work of ink eradicators or differences in inks Still in its infancy is the detection of frauds in antiques Suppose, for example, you possess a pair of glass candlesticks with dangling prisms If the two are not contemporary or some of the prisms have been lost and replaced, the substitution is easily detected Glass is fluorescent—particularly cheap, modern glass which contains uranium salts—and glass from different sections of the country and of different manufacturing eras, rarely if ever fluoresce with identical color.

OLD tapestries and fabrics lend themselves to black-light check If there has been mending it will be revealed, because old and modern dyes are readily distinguished in black light. Even furniture can be examined for antiquity because old-fashioned glues fluoresce quite differently from modern ones

Sam Hibben, one of the fathers of black light, tells of purchasing a sandstone fossil of a crustacean while traveling as a boy in Austria, and of proving its genuineness with black light many years after The fossil came under the rays quite by accident and to his surprise it glowed brilliantly The explanation is not hard to find. Fluorescence had not diminished with age and this crustacean displayed it just as do the skin and bones of fish.

Before black light becomes a reliable tool for testing antiques, standards will have to be established Your candlesticks, for example, may not be a matched pair, but which is new, which is old—which is the fake and which the genuine? Perhaps both are genuine, differing only as to place and

Several types of black light lamps. Two, of clear glass, stand beside reflector and hood of black glass. A self-contained lamp, at right of center

time of manufacture Repairs to glass, furniture, and fabrics can be ascertained, but experts will have to struggle long before they are able to place an object definitely within a given period

In Holland, black light is used for sorting diamonds It reveals source of origin rather than quality Some diamonds fluoresce brightly, others only very little If you should examine a bracelet of diamonds under black light you would find few of the gems glowing alike Some other odd but practical uses to which the Europeans have put black light are to ascertain adulterations and food quality. Butter can be distinguished from margarine because the former fluoresces yellow, the latter pale mauve, fresh eggs fluoresce red while stale ones are brown

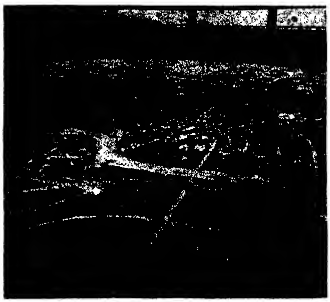
There is a very broad field in mineralogy One can distinguish many minerals in mines under black light, and companies are already using it to search out zinc and tungsten deposits— to find the richest ores and to examine scrap piles for valuable minerals discarded in error By pure chance, most of the really valuable minerals and metals fluoresce It is possible to distinguish genuine sapphires, pearls, and ivory from the artificial, to tell new cut jade from old, and to spot rubies from Siam as contrasted with those from Burma or the synthetics

A VERY simple application of black light has recently been placed on the market. It calls for coating reflectors with a substance which fluoresces red, and when used in combination with mercury lamps, a pink tint is added to make up partially for the red-ray deficiency characteristic of the mercury spectrum. Even more ingenious is the weaving of a fluorescent strand into rope, as now practiced by one manufacturer This simple trick makes possible checking up rope which fails in use to see whose product is at fault—the ingenious manufacturer's or a competitor's

Experimenters have been trying a variety of stunts to test out black-light possibilities One of the most novel has been to play cards with no illumination other than that furnished by a tablecloth of fluorescent dyed fabric and cards printed in fluorescent inks It is significant only in demonstrating how objects themselves can be made a source of light—an idea very likely to be capitalized upon Now that fluorescent substances can be incorporated in plastics, the idea gets a real boost The plastics can be formed into figurines and statuettes, into artificial flowers, and into threads for weaving into fabrics, and all these supply what might be termed artistic, indirect lighting fixtures, though the light is only a glow

Of military uses for black light, little can be said because nothing is known officially But one can hardly mull over the great advantage of invisible light under wartime conditions without having some uses come to mind. The convoy described at the beginning of this article finds its way by flashing black light on fluorescent painted markers lining the roadway, and that's just one step ahead of the present practice of using prismatic buttons Gages and controls of artillery and aircraft can be illuminated in such a manner as to be invisible to the enemy. And perhaps this is being done. The Germans must know plenty about black light because they control the Netherlands, the seat of black-light development

Both fluorescence and phosphorescence are being used in England The London bobbies have crossed suspenders which show up in the darkness of blackout traffic The entrances to air raid shelters are indicated by fluorescent mark-



"Democracity" in the Perisphere at the New York World's Fair. The effect above at left was achieved wholly by use of fluorescent paints on the city and black lights overhead, not a single inch of wiring being in the city itself. Above, at right, the tiny city and surrounding country under ordinary light

ings, or with phosphorescent paint

Black light sounds like the light the little man who wasn't there reads by, but for all its paradoxical nature it has a valuable role to play in the future. First and foremost, it affords an opportunity to achieve color and light effects by illumination which cannot be obtained by any other means In time, decorators may have to think in terms of two lighting effects It already serves industry, but here the possibilities have no more than been scratched. The lamps and fluorescent materials are available and practical and it remains only for man's ingenuity to put them to varied esthetic and commercial uses

Photographs courtesy of Calco Chemical Co, Alexander Smith & Sons Carpet Co, Stroblite Co Westinghouse Elec & Mfg Co

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Carbolic From Gases

World's Largest Synthetic Phenol Plant Is Operated By Only Six Men

Peep holes enable operators to observe first stage of process

MANY plastics employ phenol, better known to the layman as carbolic acid, as one important constituent Since the year 1834, phenol has been made from coal, an enormous amount of by-product being produced for every pound of phenol The plastics industry has grown so fast, however—from a production of 2,000,000 pounds in 1921 to more than 200,000,000 pounds in 1939—that it has become necessary to synthesize the basic materials used in their manufacture

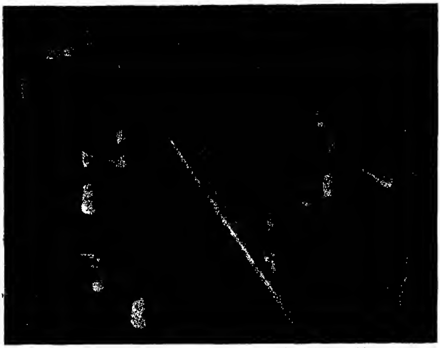
Of great interest, therefore, is the new $2,000,000 plant built at North Tonawanda, New York, by Durez Plastics & Chemicals, Inc, for the production of synthetic phenol from several common chemicals. When the acid is made by the new Raschig process, the by-products amount to less than one-tenth of a pound for each pound of phenol The plant, the largest of its kind in the world and the only one in the United States, is one of the most amazing chemical units in the world In spite of its size and the intricate processes involved, it can be operated at full capacity by a force of six men and a supervisor for each shift Operations are controlled automatically by these men at master control panels In case of motor trouble anywhere, automatic signal divisions warn the operators who can then cut in duplicate equipment from their control stations

Vapor superheater temperatures are controlled at this station

One section of the distillation building showing chlorobenzene stills. Duplicate pumps assure continuous operation regardless of breakdowns

There are several large buildings, towers, and distillation units, all joined with 40 lines of pipe, three miles of which is made of glass, porcelain, or rubber to withstand the action of acids at high temperatures. Duplicate equipment has been installed at every stage for use in case of trouble.

The process itself is so intricate that many leading chemical engineers in this country refused to consider it when it was first offered here a few years ago. Briefly, it consists, first, in passing a vapor mixture of benzene, hydrochloric acid, and air through a catalyst. This produces a mixture of chlorinated benzenes from which mono-



Portion of the intricate glass pipe manifold on top of the acid recovery tower Here the Raschig carbolic acid process starts in the second stage

chlor-benzene is distilled in the pure state for use in the second step In the second step, a vapor mixture of mono-chlor-benzene and steam is passed through a catalyst which produces phenol and regenerates the hydrochloric acid These two stages actually form a completely continuous process, and during the process most of the materials formed, and the catalysts, are recovered for re-use The process can be likened to a game of ring-around-a-rosie, the process making a continuous circle with the phenol being extracted or drawn off as it is formed, and new materials and new catalysts added as the original ones wear out or become used up

Assuring an independent and controlled source of the purest phenol obtainable in this country (above U. S P. standards) this new plant not only makes possible improved plastics but also is a definite aid in national defense, for phenol is used in some explosives

• • •

NATURAL GAS STORAGE

Changed To Liquid, Stored in Smaller Tanks

THE dream of J A Clark and R W. Miller, of Pittsburgh, engineers of the Hope Natural Gas Company, of reducing natural gas to the liquid state and then storing it at 250 degrees below zero, has come true in a new plant now being erected at Cleveland for The East Ohio Gas Company. The tanks holding the liquid gas are of special nickel steel and are insulated by walls of cork three feet thick.

Even metals lose their strength at sub-Arctic temperatures The problem of storing liquid natural gas, therefore, involved research and experiment to find materials which would withstand the harrowing cold of the liquefied fuel.

The reason for this interest in liquid natural gas is not hard to find because natural gas companies have experienced considerable difficulty in solving the problem of varying gas demands by consumers Generally, the natural gas supply and the consuming center are miles apart, joined by a pipe line Economic reasons dictate the size of such lines, and they are used only at part of their capacity in the summer time, at best.

Sometimes gas companies solve their storage problem by raising the pressure of gas in the pipe line, making this a natural storage reservoir, but it is a limited one. Other companies have used high-pressure storage tanks, but these are expensive and rather uneconomical ways of storing large volumes of gas

One cubic foot of liquid natural gas would make 600 cubic feet of ordinary natural gas if allowed to return to its natural state, and all of this would take place without any change in the gas. Thus, a big gas holder can store 15,000,000 cubic feet of gas but it would take a holder of only 25,000 cubic feet capacity to store the same amount of gas in the liquid state. This saving in storage space had such great appeal that Mr. Clark and Mr. Miller began extensive experiments as far back as August, 1937, to solve the many problems of economically liquefying and storing natural gas

These experiments revealed that the most practical method of liquefying the gas was by the so-called "cascade" system in which the gas is cooled to the liquefying temperature by passing it through four stages, each one of which is surrounded by a closed circuit containing liquids having successively lower and lower boiling points.

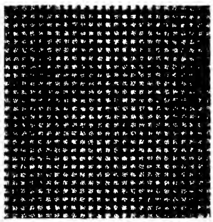
The Cleveland plant will be able to liquefy 4,000,000 cubic feet of natural gas each day and will have three storage tanks, each holding 600,000 gallons of liquid natural gas, which will be equal to a total storage of 150 million cubic feet.

Not least in interest is the way in which this liquid is reconverted into gas. This requires steam heat, and the natural gas is boiled at a speed fast enough to produce 3,000,000 cubic feet of natural gas per hour, enough to supply cooking needs of 100,000 families

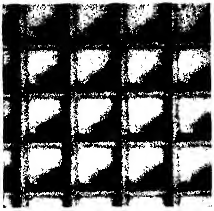
POWDER SCREEN

No Wires, No Weaving in Powder Metallurgy Product

POWER metallurgy, which was discussed in length a few months ago in Scientific American, has solved many industrial production problems. It has now been adapted



Powder screen, natural size



Powder screen, 6x

by the Chrysler Corporation to the production of fine bronze screens. The resulting screen, shown in the accompanying illustrations, is, as yet, only a laboratory curiosity. It is, however, practical from the standpoint of both use and manufacture.

This screen was made of finely powdered copper and tin, processed and molded into finished form without the necessity of first making wire and then weaving it into the required pattern.

ANOTHER SYNTHETIC

"Rubber" Made From Waste Gases

By making it as a chain of molecules to which only a very limited number of additional links can be added, American chemists have been able to produce from oil refinery gases, formerly wasted, a synthetic rubber-like substance with many advantages over imported natural rubber

Dr. Per K Frolich, director of the chemical division of the Esso Laboratories, recently gave the first technical report of the new "butyl rubber," developed by Standard Oil chemists. It is colorless, odorless, tasteless, and more stretchable than rubber from trees. —*Science Service*

COLD-SET GLUE

Easy to Use, Water-Proof, Strong

What is said to be the first cold-setting resin adhesive ever produced in the United States has been announced by the United States Plywood Corporation. Called Weldwood plastic resin waterproof glue, the product is bacteria-proof, rot-proof, stain-free, and economical, as well as water-proof and enduring. It is made under Plaskon patents.

The new glue can be used by professional or amateur. It comes as a finely divided powder which dissolves instantly in cold water and is ready to use immediately after mixing Jobs can be handled within two hours after gluing and can be worked after four hours. Since it sets by chemical action instead of evaporation, continuous submersion of the glued part results in no deterioration It dissolves only in the presence of alkalis or acids that are strong enough to eat away the wood itself, or under heat above 160 degrees, Fahrenheit.

The manufacturers claim great economy in the use of this glue, as

Rock maple, joined with cold-set glue, broke; the joint held

they advise the thinnest possible coat on the surface to be joined, the coating being applied by a spray or by a brush and then squeegeed Because of the small quantity of water used, shrinkage of dowels or close joints is minimized.

SMOKE ROUTER

Reduces Air Pollution By Smoke Stacks

A queer device that bombards smoke with high-frequency sound waves, thereby causing the smoke to lie down and play dead, is being developed by the United States Bureau of Mines. The idea is to attach one of these units to every chimney and stack, and prevent the smoke from getting out and spreading around the countryside.

Inside a piece of pipe is an aluminum cylinder which is connected at one end to a loud speaker and special radio set The radio sets up a magnetic field which causes the aluminum cylinder to vibrate, producing powerful high frequency waves. These waves are directed at the smoke and cause the particles in the smoke to coagulate into relatively large pieces of soot which fall out of the air stream by gravity.

It's still an experiment, but has possibilities of doing much to reduce air pollution by smoke, if it can be applied to large-scale service.—*Aluminum News-Letter*

HOOK-ON METER

Volt-Ammeter Snaps Over Wire

A versatile, portable instrument, a hook-on volt-ammeter for measuring alternating current and voltage, has been introduced by the General Electric Company. With it, alternating current can be read instantaneously on both insulated and non-insulated conductors simply by hooking the instrument around the line For voltage readings, it is necessary only to connect two leads furnished with the instrument and then flip the thumb-manipulated selector switch to the desired voltage position on the scale

Designed for use on conductors of 2-inch maximum diameter, the new volt-ammeter is small enough to get into tight places, light enough to be hung from a lineman's belt, and sufficiently accurate for a great variety of measuring jobs Weighing only 3½ pounds, it is designed for easy, one-hand operation Four current

Using the hook-on meter

ranges—0-15/60/150/600 amperes—and two voltage ranges—0-150/600 volts—are available at the setting of a convenient six-position snap switch. Its accuracy is within 3 percent.

An integral part of the instrument is a C-shaped, split-core current transformer so designed that it can be operated without a trigger. To make measurements, the transformer is simply pulled open and placed against the conductor

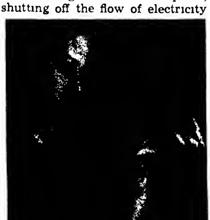
A slight push on the handle snaps the transformer shut The measurement completed, a gentle pull springs open the dovetail joint of the transformer and releases the conductor The dovetail joint assures that particles of dirt, which would cause large errors in the ordinary butt joint, have almost negligible effects on the indication

CIRCUIT BREAKER

Small, But Does A Big Job

A SIX-OUNCE electric "safety valve" was recently announced by Westinghouse Not only does this hard-boiled midget switch stop a force equivalent to 230 horsepower, but it does it in a way that is entirely new Representing an adaptation of principles involved in the design of a superior type of circuit breaker for airplanes, this device is intended to guard the lighting and appliance circuits of homes and industry

Although it is not much larger than a woman's compact, the device is able to interrupt a short-circuit current as great as 5000 amperes, shutting off the flow of electricity



Midget circuit breakers and woman's compact; compare sizes

through it in less than one sixtieth of a second

Paradoxically, this unique circuit breaker permits the passage of momentary "overloads" of electric current, which normally occur when motor-driven appliances are started, but it also operates instantly to shut off the current if the overloads become dangerous.

This dual personality is due to the use of both heat and magnetism to operate the breaker. When lights or appliances are switched on, the flow of current through the contacts of the breaker gradually heats a bimetallic strip inside the unit Since one of the metals in the strip expands faster than the other, the unit eventually bends, releases a latch, and breaks the circuit

The bimetallic strip has been designed to permit a safe amount of "overload" to pass through it before opening the breaker However, if the current increases beyond a safe margin, it not only causes the bimetal unit to trip but causes a magnet to help release the spring-latch and open the breaker instantly In less than a sixtieth of a second, the electric arc is drawn through a half-inch gap between three tiny steel plates, cut into four smaller arcs, and quenched in air

MIRACLE MEASURE

Finds Thickness of Paint To Hundred-Thousandth of Inch

MEASUREMENTS to less than one-hundred thousandth of an inch can now be made of the thickness of non-magnetic films such as paint, paper, and even rust or weathering on sheets of iron, reports the *Telephone News Bulletin*. It is done without disturbing the coating

A short iron rod with two coils of wire on it is pressed, end on, against each side of the coated iron sheet Both rods are magnetized by passing an alternating current through one of the coils on each rod This induces voltage in the other two coils The coating, which is non-magnetic, decreases the voltage on its side of the sheet by an amount which depends on the thickness of the coating

This method, developed recently by the Bell Telephone Laboratories in New York, has many uses in the telephone industry, where tests of the condition and wear of a vast amount of indoor and outdoor equipment are being made constantly to improve the service.

BUBBLE DANCE

In Oil Circuit Breaker Aids in Design

MOVING pictures have revealed to engineers of the Westinghouse Research Laboratories a "bubble dance" of elusive electric arcs Drs. Joseph Slepian and Thomas E. Browne, Jr, were seeking ways to improve the design of oil circuit

With this equipment engineers searched for data on circuit breakers, found bubble dance

breakers and discovered that the gas bubble, formed by decomposition of the oil surrounding the contacts, appears to dance as it oscillates from large to small size several hundred times a second The pictures indicate, according to Dr Slepian, that the quenching of an arc in one of these switching devices takes place entirely within a bubble of gas the size of a teacup or smaller.

This discovery of the "bubble dance" is significant for it gives the engineers a suggestion as to the direction the design of oil circuit breakers should take Indeed, Dr. Slepian believes that emphasis should be placed on the de-ionizing (removing of electrification) of the gas within the bubbles

To carry out the advanced studies necessary in this research, Dr. Browne built an experimental circuit breaker with thick plate glass windows opposite the point where the contacts separate. Using a high-speed movie camera which carried the film forward at a speed of 50 feet a second, he used a revolving glass prism to move the image at the same speed. The prism acted as a shutter, revolving 60,000 times a minute, or about 30 times the speed of an airplane propeller during normal flight

INDUSTRIAL TRENDS

INDIUM

ONE of the metals about which you have heard little but which is destined to play an increasingly important role in industry is indium. Broadly speaking it does for non-ferrous metals what chrome does for ferrous ones. It is attractive at this very moment because it has been proved that a very small amount added to bearings composed of alloys of cadmium, silver, tin, or lead, inhibits corrosion due to the organic acids present in the lubricating oils. Indium can be made to diffuse through these bearing alloys by simply coating them and heat treating, and there is no ill effect upon the bond between the alloy and the steel backing. Given the severe conditions under which the modern automobile and aircraft engine operates, indium makes a real contribution and it is no wonder that it has been seized upon to do its bit.

The earliest use of indium was to improve the quality of gold alloy castings in dental work. Another use is to lower the melting point of alloys. There are indications that casting alloys can be developed which will soften in hot water, thereby giving the medical profession something for molds. The metal added to tin seems to inhibit the phenomenon of "tin pest."

Like many of the other lesser known metals—beryllium, tantalum, molybdenum—indium was extremely costly at the outset of its use. From $300 an ounce, it has dropped to $30 for the electrolytically pure and $15 for other grades. Since a pinch of it goes a long way to produce valuable results it cannot be called a prohibitively priced metal. Furthermore, there's plenty of it in the country.

MORE MILES PER GALLON

There's an added significance given to work to improve bearings when one hears what the engine and fuel people plan for the future. Not content to have improved these two factors in transportation to an extraordinary degree, they want to jump farther. T. A. Boyd, of General Motors, declares that the use of a 100-octane number gasoline instead of 70 in experimentation has given a 55 percent increase in miles per gallon at 20 miles per hour and more than 40 percent increase at higher speeds. He points out that with an absolutely knock-free fuel one can get double the power or nearly double the mileage, but not both at once. Thus far the public has demanded the added power, but in the future it may favor greater economy and that would bring about smaller displacement engines than those in use today.

There hasn't been much said about a motor fuel famine in late years for the very patent reason that research has made possible extraction of double the amount of gasoline from the crude oil and thus upset all the sound calculations of those who "viewed with alarm." Given fuels that will deliver the power and engines that will take it, focus attention on the merit of economy now that excellent performance is commonplace, and the net result would be more inexpensive motoring and a conservation of our petroleum resources to postpone still further the day when motor fuel must be obtained from other sources.

TRANSPARENT FILM

Ethylcellulose cast in brilliantly clear transparent film is coming into commercial prominence for modern packaging. Under the trade name of Ethofoil, it is getting into large-scale production now that users have given it an extensive tryout.

The properties which recommend this newer among the packaging materials are many. It is easily fabricated by light or deep drawing, much in the manner of metals, to make objects which have definite form while retaining their flexibility under long aging and high temperatures. It can be produced in opaque, translucent, or transparent colors, it can be sealed with adhesives, stapled, or rivetted, and it is readily printed. Ethofoil is not flammable but will burn with a slow flame. It is not affected by alkalis and is resistant to dilute acids. It transmits about 90 percent of visible light and a large proportion of ultra violet. The rays absorbed by window glass pass through the foil.

MORE NYLON

There's no gainsaying that nylon is a "natural" in the commercial world. With the announcement of the building of a new plant to raise the aggregate production to 16,000,000 pounds, Du Pont declares that this total is five times what was contemplated when the first plant was authorized in 1938. It is a snowball rolling up to huge proportions and it is a safe guess that world conditions are giving some of the shove.

The United States takes about 78 percent of Japan's silk output. If we take last year's consumption of 50,000,000 pounds, we see that nylon will be ready to fill one third of silk requirements by 1942, and that will mean a beating of all records—even those made by the fast growth of Cellophane.

ADMIRALTY METAL

Adding a small amount of antimony to the formula for the well-known admiralty metal gives a product which resists dezincification, sulfur corrosion, and inter-crystalline corrosion.

Antimonial admiralty is particularly suited for heat exchangers, condenser and evaporator tubes, offering as it does resistance to corrosive water conditions as well as sulfur corrosive conditions. It is not without wartime significance now that the Navy has embarked on an expansion program.

PHOSPHORESCENCE

You've read elsewhere in this issue that black light is going to town very largely from the boost given it by blackouts. Paralleling the rise of black light is the use of phosphorescent materials. Just around the corner is a phosphorescent wallpaper with no war implications. It will be produced primarily for use in un-modernized hotels and boarding houses lacking bedside light switches. On switching off the light, the wall paper will glow for a sufficient time to enable the occupant to reach the bed without colliding with the rocker. Why not for nurseries of children afraid of the dark?

—*Philip H. Smith*

Four Centuries Late

Science and Society Begins to Recognize a Great Inventor, Engineer, and Scientist

ALBERT G. INGALLS

ALONG in the 'twenties and 'thirties a good many Americans came to the realization that many of us had been too emotional and some of us even hysterical in some of our attitudes connected with World War I In our rage against our opponents many of us also condemned his literature, art, and music, not alone contemporary but past. For example, many would not play Beethoven's music because Beethoven was a German, though he had been dead 90 years and had nothing to do with the events that led up to that war Today, the great majority feel strongly about events political and military in the Old World, but it is pleasing to note that many have vowed they will not this time let their emotions run entirely away with their common sense, at least where things like art and music and science are concerned—things that belong to the whole world and to the ages.

When, some weeks ago, the New York Museum of Science and Industry obtained from Italy a collection of 275 working models of the inventions of the Renaissance Italian inventor, engineer, physicist, biologist, architect, and artist, Leonardo da Vinci, and put them on exhibition after they had similarly been on recent exhibition in Milan, nothing untoward happened Nobody planted a time bomb or even thumbed his nose Of course, the Italians, in willingly lending these models to the American institution, aimed without much doubt to enhance Italian prestige, but New Yorkers and others have flocked to see them, and still are flocking, probably because they simply wanted to see them All this shows that, since 1914-1918, the nation may have to an extent grown up.

Perhaps the reader has noted that, in referring to Leonardo above, the word "artist" was mentioned last, "inventor" first, reversing the customary sequence, Leonardo usually being thought of primarily as an artist. The motive is not to belittle art, which could not be done, but to help redress a bad balance of long standing If, a generation or more ago, one had asked the first 100 persons whom he encountered who Leonardo da Vinci was, it is believed that at least 90 might have replied simply, "A very great artist." Perhaps nine more might have been aware that Leonardo also dabbled in science, and maybe one out of the hundred, fully aware of his greatness in realms scientific, would have said that Leonardo was so able in that realm that a time would come when his abilities in it would be recognized as the equal of those in art That time has begun to arrive

IT is now approximately 450 years since this "tremendous universal genius" was doing his best life work, yet, even this long afterward, we know a very great deal about that work, also about the man himself. For example, we know from contemporary record what manner of man he was personally. The rather cantankerous disposition traditionally associated with great genius appears to have been no attribute of Leonardo's. His was a warm, sunny personality; he made many friends and kept them Physically, he was not a latin type; he is spoken of by contemporaries as golden haired.

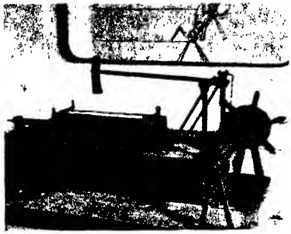
We also have, in different large libraries, the actual originals, well preserved, of the 7000 pages of notes which Leonardo penned throughout his lifetime, in which he preserved his thoughts and conceptions in the realms of aeronautics, anatomy, architecture, astronomy, botany, engineering, geology, mathematics, medicine, optics, physics, and other corners of science; for he took the whole universe as his scope. All this and other available first-hand material affords us what might be called an "in-focus" picture of the man, rather than the somewhat fuzzy, blurred, out-of-focus picture we have of many great men who lived at even later periods—Shakespeare, for example, who lived a century later

No man of Leonardo's artistic and mechanical flair would be likely to write out 7000 pages of notes without also drawing some pictures, and thus it is that very many of these manuscripts are copiously illustrated by clear, definitive sketches, not alone of things he had seen but of things he had invented—machine designs It is from these original notes and sketches that the modern Italians made their 275 working models, many of them full-scale, of Leonardo's inventions, a few of which are shown on these pages.

Here one might be pardoned if the suspicion rose in his mind that the modern Italian model makers might perhaps have improved on them a bit while they were at it—people often do this, unconsciously, when their heroes are involved In the present instance there was, however, no need to do so. It is true, Leonardo did not leave dimensioned blueprints, whether of a screw-threading machine design or that of an airplane, but his sketches are as clear and definite as an engineer's notebook sketch would be if made in 1940. Thus, in judging Leonardo's abilities, little "courtesy allowance" need be made for the man's times. You get the impression, after studying his con-

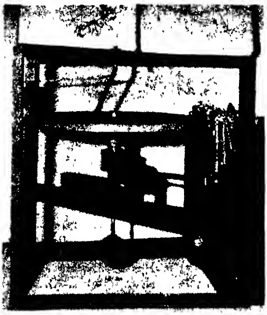
Leonardo's design for an engine of war—a tank; also his script, written from right to left, a natural, logical direction for a left-handed writer

ceptions, that this was an artist who also felt as fully at home in the world of mechanics as our engineers do today. He quite obviously had a modern mind. In fact, it does not seem exaggerated to inquire whether, had the man been born in 1847, as Edison was, instead of 1452, he would not have equalled Edison as a conceiver of inventions, not to mention his far greater versatility in other fields than invention He invented a helicopter, the double-hulled ship, a pile driver that looks remarkably modern, the power-driven band saw, a cannon actuated by steam, the rolling mill, pumps, lens grinding machines—many other practical things

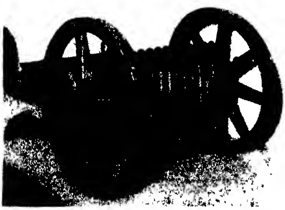


A file shaper built from Leonardo's design (*right*). The file blank was to be clamped on the bed-plate moved by the lead-screw, while the cold-chisel on the tilt-hammer indented the teeth serially in it

Beyond invention, Leonardo went far, for his time, into physics. He determined coefficients of friction, hinted at the principle of virtual work, studied out the principles of the composition of forces, and discovered the fallacy of perpetual motion. He also foreshadowed the principle of inertia which Galileo demonstrated a century later, and clearly defined what still later became Newton's Second Law of Matter (Galileo and Newton had no access to Leonardo's writings and probably did not know that they existed).



The first mass-production machine. Designed to point a number of needles simultaneously, against its horizontal, rotating abrasive wheel



This multiple cannon was not a "machine gun," as is sometimes stated, yet it is based on the mass-production principle of one. While top bank of barrels was being fired, the bank in front was cooling and the one behind was being loaded

There are at least three reasons why Leonardo's great work did not have the expectable impress on scientific advance.

First, he did not publish it.

Second, in his time no organized, far-seeing industry existed to take up discoveries and inventions, as exists in ours. Not alone this but in that age people in general were not prepared to see the value of science. Leonardo's contemporaries, for example, regarded his mechanical and similar activities merely as whims and notions, in which he was good-naturedly indulged by them because of his worth-while artistic activities.

Third, Leonardo himself lacked persistence and the businesslike, promotional type of enterprising makeup When contemporaries failed to grasp the significance of a given idea or invention, he did not try hard to convince them or to push it himself but simply returned to his sport of thinking up more ideas Moreover, he was inclined to lose some of his own eager interest in these ideas as soon as he had set them down on paper where they could not get away, probably this signified mainly that more ideas were pressing hard from behind

Can it not therefore well be that the price paid by the world for Leonardo's sunny, extraverted, sociable, but perhaps insufficiently pushful, personality was just about a solid century of delay in the arrival of our Age of Science on the world stage? If he had found a way to set his conceptions in actual movement it is altogether likely that we might be, today, where we now expect to be by 2040.

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SAVING SNOW

Plowed into Rows, It Prevents Later Drifting

You'd think there was enough snow in Canada without hoarding any—but the Department of Agriculture in Saskatchewan has announced the development of a new technique for snow conservation, reports *Ethyl News* In many parts of the country, farmers look to the melting snows of spring to do the work of early showers in wetting and softening the soil for plowing and planting. And since it is important to keep the snow right on the land where it will be needed

later, many experimental methods have been tried to prevent it from migrating

The latest and simplest — and perhaps most successful — way of "tying down" the mantle of Jack Frost has been evolved by G. E. Matthews, superintendent of the Experimental School run by Saskatchewan in the town of Scott He drags a pair of especially constructed snowplows behind a tractor, lays each level field out in ridge-rows, and the problem is solved The ridges anchor succeeding drifts

Canadian farmers and scientists alike have long tried to make an ally of the winter snows — getting them to wet the soil instead of running off in streams that cut gashes through the fields and leave other spots so dry that wind erosion carries away the good topsoil Many a farmer has had to re-seed, not once but twice, while his seeded and cultivated soil has blown across the road to bury another crop

WOOD BRIQUETTES

In the larger cities of the West—Los Angeles, San Francisco, Portland, Seattle, and Spokane—housewives can buy a new type of fireplace log in grocery or neighborhood stores, service stations, or from the ice man These neat, clean, and uniform cylindrical logs are pressed from sawdust and shavings from sawmills The magazine *American Forests* reports the ever widening use of this product which provides a method of salvaging great piles of sawdust formerly wasted, or, at best, inefficiently burned in saw mill furnaces

One of the logs weighs eight pounds and is the equivalent in fuel value of an armload of ordinary wood or a bushel basket of waste shavings Three times the specific gravity of the original wood, these logs will not float on water

The process of making cylindrical fuel briquettes is not exactly new, as the machine was first developed some years ago That machine has, however, been so improved that production on a large scale is possible The sawdust holds together in briquette form solely through materials it originally contained — no string, wire, or sticky binders being used The secret of its success is enormous pressure under which it is compressed—around 165,000 pounds

One log equals an armful

HINGED BUS

Threads Traffic, Carries More Passengers

There recently appeared on the streets of New York a unique vehicle in the form of a bus, longer than usual, and hinged just past its mid-section This is a new departure in surface transportation for cities of dense traffic The articulation of the two sections permits a shorter turn than would be possible with a rigid bus of such length

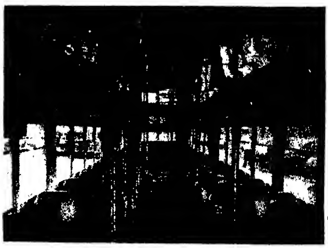
The new coach is 47 feet in overall length, 96 inches in overall width and seats 58 passengers, which is the capacity of the ordinary street car Each of its two sections consists of the usual all-metal body construction riveted and gusseted to a steel underframing The two sections are joined at the center on a horizontal plane by means of a hinged section in the underframing, permitting front and rear sections to move up and down irrespective of each other A prestretched rubberized covering provides flexibility at the joint Reverse steering on the front and rear axles gives the unit a smaller turning radius than an ordinary 40-passenger bus Hence, it may thread its way through heavy traffic with ease

This Super-Twin coach, made by the Twin Coach Company, is propelled by a Diesel engine of 175 horsepower, or it may be used as a trolley coach, obtaining the electricity from overhead high-voltage wires

"MAILED"

Time Capsule Sealed In

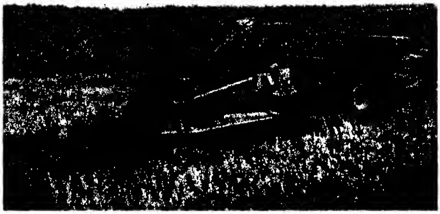
That 800-pound "letter to the future," the Time Capsule, which was buried in an open pipe before the Westinghouse exhibit building at the New York World's Fair, has now been finally "mailed" During the first season of the Fair, and until late in September of the second season, millions of Fair visitors inspected the Time Capsule as it rested at the bottom of its open



Exterior and interior of the hinged bus that will reduce traffic difficulties

pipe container On September 23, 1940, it was finally sealed off by Dr Clark Wissler, archeologist of the American Museum of Natural History. Dr Wissler turned a crank which emptied from a large cauldron 500 pounds of a compound made of pitch and other chemicals —a special compound concocted for long keeping qualities

The site of the Time Capsule will be marked by a monument It is firmly believed that no human eyes will again see it until archeological ages have passed



Mobile unit salvages ties from an abandoned railroad

TWO-WAY TELEVISION

Demonstrated By Amateurs: Low Cost Equipment

RECENTLY announced was the opening of a two-way television circuit, operated by radio amateurs, the distance between the two ends of the aerial line being approximately eight miles

Mr George Bailey, President of the American Radio Relay League, the nation-wide organization of radio amateurs, who flew from Boston to dedicate the new circuit, said "The American Radio Relay League is indeed proud to have a part in this latest indication of the thorough-going, practical-mindedness of the American radio amateur The conception of having two complete duplications of equipment, for a two-way demonstration and then arranging for simultaneous voice transmission is one of the things we would expect from Arthur Lynch, whose interest in all amateur radio activities is well-known We are confident that this exhibition will be another link in the chain which is binding the amateur radio man closer and closer to the average radio listener

In commenting on the circuit, Mr Lynch said "The picture circuit is operating in the 112-116 megacycle amateur band—having one transmitter near the lower end, the other near the upper end This band, if expressed in the more commonly used terms, would be said to be on two and one half meters

"The system which we are using can never be made to compare in clarity with commercial television We use a system which gives us but 120 lines, while the commercial standards are in the vicinity of five hundred lines Then, too, the amount of power we use at our transmitters is only a very small fraction of the power used by the commercials The cost of our equipment is extremely low, in comparison A complete transmitter and receiver, of the type we are using on each end of our circuit, can be duplicated by any amateur for less than three hundred dollars That includes all the tubes, but it does not take the voice channel into consideration

"Our voice circuit operates on two frequencies in the 56-60 megacycle band, which is the equivalent of approximately five meters The transmitter is equipped with several crystals, so that one of several voice channels may be selected at will, while the receiver is made with an automatic noise-gate, which prevents any sound coming from the loudspeaker until the voice of the operator on the other end of the circuit is heard

Two-way amateur television set-up. Camera at left, receiver tube at right

UPROOTER

Abandoned Railroad Beds Quickly Cleaned Up

A MACHINE which eliminates the tedious job of tearing up old cross ties from abandoned railroad beds and hand-loading them on trucks has been developed by the Athey Truss Wheel Company Mounted on a Caterpillar tractor, this mobile loader pries up the old cross ties, swings them overhead, and slides them down a chute in the rear so that they are loaded onto the body of a truck

As shown in the accompanying illustration, swinging arms are mounted on an axle near the rear axle of the tractor Meeting in front of the machine, the two arms terminate in a two-prong, wedge-shaped fork which gouges under the old cross ties as the tractor is

moved forward. The prong holds several of these cross ties as the arm swings up on the framework mounted over the tractor and drops its load when almost directly over the tractor driver. The cross ties slide down a flat chute to the truck The truck is coupled to the tractor so that as the tractor moves the truck always follows.

This machine will dig up and load an average of 10 ties every 20 seconds, and with it a contractor is able to clear a mile of right-of-way per day

CONTOUR FINDER

ENGINEERS of the immediate future won't be forced to await the findings of ground survey crews, with the advent of the compact little "contour-finder" developed by the Abrams Aerial Survey Corporation the situation is changed.

The contour-finder, adapting a principle used by our grandparents—the stereoptican—measures elevations of trees, hills, and buildings directly from a set of two aerial photographs. The drawing attachment accurately describes minute measurements, enabling engineers to run profile lines along rights of way, locate and draw contour lines around dam sites and drainage areas and obstructions in engineering work Tedious ground-crew survey work is thus done away with, engineers being able

Close-up of contour finder

to locate "control points" in a short space of days

The contour-finder was designed to complement the work of aerial survey crews mapping projects from high altitudes

The instrument is a compact one equipped with a drawing attachment for obtaining topographic information from vertical aerial photographs or from oblique photographs which have been accurately rectified.. It consists of six parts. stereoscope, parallax measuring unit, drawing attachment, lighting unit, carrying case, and, optionally, an alignment mechanism.

In operating the device, a pair of stereoscopic aerial photographs are placed under the instrument in such a way that two indicating dots cover the same point in both photographs. The dial gages are set at the mid-point of their range The photographs must be at right angles to the instrument and the dots in direct line with the line of flight or base line of the photographs They are then fastened securely to the

Contour finder in use

table If the hand on the large dial is turned clockwise, the dot will appear to rise in the stereoscopic model and vice versa

By keeping the instrument in alignment with the pictures and moving the instrument with the floating dot always in apparent contact with the ground, a contour line can be traced on to another map of equal scale Higher or lower contour lines can be traced by raising or lowering the floating dot the desired vertical distance and then tracing out the constant elevation The heights of buildings, trees, and ground elevations can be measured quickly.

FOLSOM MAN

His Actual Bones Never Found

DR FRANK H. H. ROBERTS, JR, Smithsonian Institution archeologist, last summer continued excavations for the fifth season at the oldest known inhabited site in North America—the Lindenmeier site in northeastern Colorado

This apparently was a summer hunting camp of the wraith-like makers of the peculiar type of spearhead known as the "Folsom point" which is found associated with the bones of extinct animals and in geologic strata dating from the closing centuries of the last great ice age.

Dr Roberts has obtained not only a large number of Folsom points, and bones of animals eaten by the hunters, but also many artifacts used in their domestic life, such as stone scrapers and knives. Thus far he has been unable to find any human bones.

There is still hope, Dr. Roberts believes, of finding a skull of one of these Americans of 15,000 years ago. It is possible that the dead were not buried but were left exposed on the surface to be devoured by the vultures. The bodies may have been burned or there may have been a special burial site which has not yet been uncovered.

DIESEL FILTER

Cheap, Easily Removable, Protects Engine

AN ingenious and highly effective filter has been developed by the Caterpillar Tractor Company for use in that company's Diesel engines So efficient has this comparatively simple innovation proved that laboratory tests show the new filters increase the life of Diesel injection pumps and injection valves by as much as 75 percent as compared with the usual edge-type metallic filters

The filter elements consist of a high quality, highly absorbent type of cotton yarn, wound on an inner metallic screen, which is wrapped with a filter paper Winding of the yarn is done in a cellular pattern, with accurate spacings which are controlled in such a way as to provide increasing density toward the center Thus finer and finer particles are removed as the fuel approaches the center. In case an extremely fine dirt particle passes through the main elements, it is stopped by the filter paper.

The elements are easily remov-

Sectional view of Diesel filter

able and are so inexpensive that they are simply thrown away when dirty, and quickly replaced. There is a gage, mounted on the engine, which shows the operator when replacement is necessary. Elements may be removed by simply removing the cover on the centrally located filter housing, and lifting them out.

FOR WINTER

Permanent Type Anti-Freeze

"STET," a new ethylene glycol anti-freeze, has been added to the product line of the automotive accessories division of The B. F. Goodrich Company.

The anti-freeze, the first ever offered under the Goodrich name, is of the permanent type, one filling furnishing radiator protection against freezing all winter

Odorless, the new compound will not evaporate or boil away; rust inhibitors prevent rusting. The new product will not damage car finish, mixes readily with other ethylene glycol anti-freezes, and can be tested with the standard hydrometers for such fluids.

MINIATURE ROOMS

Observer Sees Self In Them

A MAGIC MIRROR that projects the observer into a series of miniature rooms is the feature of the new Alexander Smith Colorama Exhibit at Rockefeller Home Center at New York's Radio City. An involved optical system actually lets you see yourself, reduced to one eighth actual size, standing in the middle of a perfectly proportioned little living room less than eighteen inches long. Most remarkable of all is the fact that you see a side view of yourself, full length, exactly as others see you and as you have never before seen yourself except, perhaps, in motion pictures

While you have been admiring yourself in miniature, a recorded voice has been patiently explaining the theory behind the Colorama Exhibit — that women should choose color schemes for their homes that flatter their particular type of beauty. The first room, the voice explains, is for a blonde. At this point a curtain descends over the aperture through which you have been looking and when

it goes up again you find your image in another room identical to the first except for the color scheme This goes on until you have seen yourself in five little rooms

The optical system that reduces you to one eighth your size and projects you into the miniature rooms is not quite as complicated as might appear at first blush A full length mirror well to one side of where you stand picks up your image, and lenses focus it on a "transparent mirror" behind which is one of the miniature rooms The "transparent mirror" can function either as a mirror or as a piece of clear glass depending on whether the light in front of it is greater than that behind or vice-versa As you stand looking into the aperture, a brilliant light illuminates your figure and thus when your reflection in the full length mirror is focused on the "transparent mirror," the part of the latter that receives the image acts as a mirror, whereas the rest, because the lighting in the little room is less intense, is perfectly transparent and allows you to see through the glass to the miniature room behind The illusion that you are actually standing in the room is complete

BRIGHTEST FLASHLIGHT

Small Light Throws Powerful Beam

WHAT is believed to be the brightest portable battery light in the world, smaller than a man's head but so powerful that it is possible to read a newspaper by its light half a mile away, has been developed by Mr Jackson Burgess of the Burgess Laboratories

The new portable lantern, with 180,000 maximum beam candlepower, is 180 times as powerful as the best two-cell flashlight on the market

180,000 beam candlepower

The spot of light cast by the lantern at arm's length is 45,000 foot-candles, which, by mathematical calculation, is four and one half times as bright as sunlight on a spot of the same size Theoretically, at 100 feet it has 180 foot-candles which is equal to the average office illumination The light output of the new lantern far exceeds that of an automobile spotlight or two automobile headlights

The new light may be used by fire and police departments as emergency standby lights, and as an emergency landing light for airplanes It may also be carried in planes to be used in emergencies as protection insurance, similar to the way in which modern air transports carry battery-operated radio transceivers

COOL SHIPS

First to Air-Condition All Staterooms

For the tropics: 17,500 tons, all staterooms air-conditioned

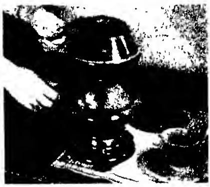
SOMETHING new in hand-made weather for tropical waters will be introduced in 1941 when Moore-McCormack's American Republics Line supplements its regular services to the east coast of South America with four new combination passenger and freight liners

The new liners will go in for air conditioning in a big way They'll feature it not only in public rooms —as the newer ships are doing—but for the first time will also install it in each and every stateroom

Pioneer vessels to be thus equipped, the new liners will accommodate 196 passengers and are being built because of the greatly increased interest of Americans in touring South America Of 17,500 tons displacement, the ships will be 492 feet overall and will have a molded beam of 69 feet six inches Their two Diesel engines will develop 9000 horsepower and give them a speed of 17½ knots

AUTOMATIC COFFEE

TO the automatic toaster which has graced many breakfast tables for years, may now be added an equally automatic coffee maker Embodying all the features of existing glass coffee makers—clean glass bowls, fascinating operation,



Better coffee—automatically

and ease in making good coffee—the new device eliminates certain disadvantages which have been experienced by coffee makers

The Alnico magnet, versatile General Electric product, is the key to this new appliance A small cylindrically-shaped Alnico magnet, coupled by suitable levers to a pair of contacts, is held in its upper position by a small stainless steel keeper located on the lower end of the lower bowl tube. As the last of the water is forced into the upper bowl, excessive turbulence in the tube breaks the circuit, allowing the magnet to drop and turning off the unit As the brew returns to the lower bowl, a thermostat turns on

a separate warming element which maintains the coffee at a temperature of approximately 185 degrees for an indefinite period

INSECTS

Follow Armies of The World

If history is allowed to repeat, say officials of the Bureau of Entomology and Plant Quarantine, the present war may add to the insect pests that have invaded new territory because of armed conflict among men The Hessian fly, which each year destroys wheat with an estimated value of $13,000,000, came here with the German troops hired by George III to suppress the rebellion Turning the tables, the Colorado potato beetle crossed the ocean in 1917 with the American army and settled in France, subsequently spreading to Germany where it is a serious threat to an important food crop. During World War I, Australian wheat replaced American wheat which had been shipped to Europe Some believe these importations introduced flag smut in America

CHRISTMAS TREES

Fireproofed by Simple Treatment

Many people preserve their Christmas trees for long periods by inserting the butt in a container of water The live tree absorbs water, sending it through all branches and leaves so that the decorated tree may stand for many days

This ability of the tree to send water throughout its structure may be made use of to fireproof the tree According to *American Forests* magazine, Dr Martin Leatherman, associate chemist in the United States Department of Agriculture, has found that fairly concentrated solutions of ammonium sulfate or calcium chloride will usually do this job effectively. Dr. Leatherman says that the trees to be so treated should be as fresh as possible. Before treatment, an earthen crock, glass jar, or a galvanized pail should be available Then the base of the tree should be cut on a long diagonal slant or in the form of a narrow V. The chemical preferred is ammonium sulfate, because it is cheap, effective, and easily obtained. The quantity to use should

be one fourth the weight of the tree It is dissolved in the ratio of one and one half pints of water for each pound of chemical. The tree is then set in the solution and away from direct sunlight until most of the solution is absorbed. Dr. Leatherman obtained best results when the surrounding temperature ranged between 55 and 65 degrees, Fahrenheit. The solution absorbed more readily at this temperature and the foliage retained its green color longer than when treated in a warm room.

Treatment of trees in this manner does not mean that all fire hazard has been eliminated but only that the tree itself will not readily catch fire. Other decorations used with it should, therefore, be of fireproof quality

MAGNETIC ALLOY

Holds More Permanent Magnetism Than Any Other

A NEW magnetic alloy of remarkable qualities, "Vicalloy," was announced recently to the American Physical Society by E A. Nesbitt and G. A Kelsall of Bell Telephone Laboratories of New York. Composed of cobalt, vanadium, and iron, the alloy can be made to hold more permanent magnetism than any other commercial material In addition, it can be drawn and rolled—a property of advantage in many applications, and not possessed by other permanent magnet materials of importance in the art For example, it has been rolled into tape 1/500 of an inch thick and 1/20 of an inch wide Several thousand feet of this tape were used for sound-recording at the New York World's Fair, while shorter lengths are running constantly as endless loops in the Bell Telephone weather-announcing systems

A tiny loop of Vicalloy supports several pounds of iron

Taking its name from the initial letters of its three components, the new material is composed of 6 to 16 percent vanadium, 30 to 52 percent iron, and 36 to 62 percent cobalt. From the molten state, it is cast into an ingot, which is hot-swaged to ¼ of an inch diameter. It is then drawn into wire or rolled into tape, as desired. When in final form, it is heat-treated to develop its magnetic qualities. It is permissible to use a heat treatment that will not be harmful to most high-permeability materials. Thus it is possible to weld such pieces to the magnet and heat-treat them both together.

GIANT TESTER

Materials Testing Machine Very Accurate

A 100-TON materials testing machine, so powerful that it can bend two parallel, 12-inch, steel I-beams, yet so accurately controlled that it can crack a nut without crushing the kernel, has been built by the Riehle Testing Machine Division, American Machine and Metals, Inc. Riehle directing designers have released the following specifications: 34 feet high, 21 feet wide and 24½ feet from front to back The transverse table, one of the largest ever built, is 8 feet wide.

100-ton testing machine. Note the man on the transverse table

Not only is the machine one of the largest ever built in the United States, as well as the world; it is also among the most accurate. Though it can exert a maximum of 700,000 pounds pressure, the mechanism has recorded a maximum error of 0.06 percent, making it one of the most sensitive machines of this type ever built. German technicians refuse to build machines more accurate than 1 percent — sixteen times greater error than this machine.

In routine tests the machine snapped 12 by 12-inch wooden timbers with a pressure of 500,000 pounds. Steel tubes three inches in diameter were crushed at 600,000 pounds pressure.

When finally set up, this machine will be used for routine testing and as a primary standard for the verification of calibrating instruments. It required eight months to build; two months were spent in design alone

WEATHER NERVES

Basis Found for Effect Ridiculed as "Just Imagination"

IF YOUR temper and nerves get more edgy when a storm is approaching, it is probably because the water balance in tissues of your body actually is disturbed due to falling barometric pressure outside. Advancing this likelihood, Dr C A. Mills, of the University of Cincinnati College of Medicine, advocates that scientists should closely investigate body changes thus involved when stormy weather brews.

Suicides are more likely to occur when a storm center approaches, Dr Mills stated Domestic troubles flare up most readily. It is harder to think clearly. Even animals become more inclined to fight, and less reliable. "With declining outside pressure," he explained, "tissues take up water and swell, much as does a sponge, while with rising pressure they give up water and shrink." In girth measurements of his own leg just below the knee, he observed changes of half an inch or more with major weather changes, and some people changed several pounds in weight.

OUTWITTING GRAVITY

Of Two Identical Balls, One Is Lazy

TWO steel balls of identical weight and size recently disproved one of the rules of gravitation by rolling

Same weight, differing "gravity"

at different speeds down an incline Dr Phillips Thomas, Westinghouse research engineer, performed the experiment to demonstrate how the friction of tiny particles of loosely packed powdered tungsten inside one of the balls made it lazy by absorbing part of its energy

Westinghouse engineers, Dr Thomas explained, have used this same principle of energy absorption to prevent electrical relay contacts from bouncing apart when they are closed, thus eliminating sparking and reducing wear on electrical control equipment

MILDEW PROOFING

Simple Home Treatment For Fabrics

MILDEW can be prevented This is the conclusion reached by Margaret Furry, Helen Robinson, and Harry Humfeld of the U S Department of Agriculture after studying 135 recommended treatments. Of these, 35 were effective, about 10 practical for home and farm use Tests are continuing in the home economics laboratories

Use of such finishes will save money, these investigators point out. Mildew proofing will help preserve tents, tarpaulins, sails, sandbags, and other pieces of canvas equipment often stored in moist or poorly ventilated places. In the home, shower curtains, awnings, and canvas on porch furniture may need treatment. Untreated cotton fabrics are likely to mildew—then develop discolored and musty-smelling spots. They may be attacked so severely that they rot and fall to pieces.

Directions for treating an average-size shower curtain illustrate

one of the simplest methods and call only for a good laundry soap and crystals of cadmium chloride, available at drug stores. Have the cloth thoroughly clean Heat it in a solution of one to two ounces of soap to the gallon of water About one and one half gallons will cover a shower curtain Heat 20 minutes, remove the cloth, and squeeze out excess soap Put the wet cloth into a second solution of cadmium chloride crystals, three ounces to the gallon of water, about one and one half gallons required Heat for about 30 minutes, wring out, and dry without rinsing Hang to dry on a twine line (a metal line may stain the fabric) This treatment does not affect the color of the curtain, which will be resistant to mildew until laundered again

PLAINS PREHISTORY

Five Stages of 10,000 Years

LONG before covered wagons of white settlers jogged toward the West, at least two great migrations of red men, their wives, and children plodded westward on foot to possess the Great Plains

New chapters of the central Great Plains prehistory, reconstructed by Dr Waldo R Wedel of the Smithsonian Institution from archeologists' burrowing into Indian ruins and searching Plains terrain, can be briefed as follows

1 About 10,000 years ago, the first men and women peopled the Great Plains, roving eastward from the Rockies Nomad bison hunters, they were some of the early Americans identified by the distinctive stone dart points known today as Folsom and Yuma weapons

2 Then came a blank chapter, enormously long, when the Plains were apparently abandoned by man

3 The first easterners re-discovered the Plains They moved cautiously, were not numerous, and were peaceful Indian settlers, not wandering hunters

4 Later a second migration of different, more progressive Indians arrived Also peaceable, these easterners brought the gift of corn, made better pottery They were mound building tribes Mysteriously, these best settlers abandoned their homes and vanished, before white men saw the Plains.

5 The Spanish conqueror, Coronado, seeking non-existent golden cities, marched from Mexico as far as Kansas in 1541, and was the first white discoverer to view Plains tribes. Nomad hunters were on the rise, harrying Indian settlers Provided in time with white men's firearms and horses, the Indian hunter became ruler of the Plains, ending Indian dominance with a brief bison-hunting era—as bison hunters had begun the conquest
—*Science Service*

LUMINOUS BRICKS

GLASS bricks have been used more and more widely, because of several advantageous features, during recent years Soon it should be possible to erect walls of glass bricks which admit daylight during the day and are luminous at night This glowing light from the bricks at night would be so well distributed that there would be no bright spots

Electricity is passed through these bricks, which are coated inside with fluorescent material similar to that used in the widely-known fluorescent tubes If ultra-violet light is needed in a room, the bricks can be made of materials which transmit these rays, while a small amount of mercury inside each brick would be used as the source of the ultra-violet

Rights to this invention have been assigned to the General Electric Company

NEW CORNET

Design Changes Improve Playing, Tone

SLANTED pistons and a new tone spiral are features of a cornet and trumpet recently developed by a leading American manufacturer Tests indicate unusual playing ease, substantial power, and added high tones for the new designs.

While the conventional horn is built in an oval spiral, with the mouthpiece at the level of the bell the new models provide an ever-rising air flow. The mouthpiece, at which the tone column originates, is the lowest point of the tubing when held in playing position This

". . . ever-rising air flow"

Piston valves on an angle

feature, the makers believe, may account in part for the ease and flexibility of tone production

By installing the piston valves on an angle, a more natural and relaxed position of the hand and fore-arm is permitted, which in turn leads to improved muscular control and facility

DANGER UNIT

Degree of Danger In Driving Cars

TO MEASURE the hazard involved in driving at various speeds, the Travelers Insurance Company has developed the "danger unit" which is defined in stopping distance, roll over, vertical fall, and turning radius, reports the *Stone & Webster Bulletin*

Under average conditions the distance an automobile moves after its driver has decided to make an immediate stop varies as the square of its speed. A "danger unit" equals 35 to 40 feet of stopping distance A car traveling at 25 miles per hour can be stopped in this distance, while in stopping from 50 miles per hour it will travel between 140 and 160 feet, the equivalent of four "danger units" Nearly one full "danger unit" is added when the speed of a car is increased from 45 miles per hour to 50

In case of too sharp a turn, a car will sometimes roll over once for each "danger unit" it carries Thus it may roll over once at 25 miles per hour, twice at 35, and perhaps nine times at 75 It is well to remember that only in the luckiest accident can the driver cling to the inside of the rolling car as it does its three turns at 45.

Striking a solid object at 25 will do a car about the same damage as if it had been driven off a two-story building Encountering a stone wall at 50 will be just as serious as if it dropped from four times two stories, or eight stories When Captain George Eyston was doing 300 miles per hour and more on the dry salt beds of Utah, his big engine was packing energy into his car with such industry that it was adding one "danger unit" for each mile of increased speed Had he hit a solid stone wall he and his machine would have been smashed as completely as if he had driven off a 3000 foot ledge into Grand Canyon

Each added "danger unit" causes the car to require a longer turning radius Thus a car can make only one fourth as sharp a turn at 50 as at 25, one ninth as sharp a turn at 75 as at 25

RUBBER GLUE

Non-Flammable, No Odor, Keeps Well

A NEW cement, Texglue, with a latex or rubber base, and compounded to afford exceptional adhesive properties and resistance to aging has been announced by The B F Goodrich Company It contains no flammable solvents

The new product is of special interest to upholsterers, awning manufacturers, and leather fabricators as well as to anyone having any requirement of adhesion of fabrics, paper, leather, or other porous materials Texglue also will attach fabrics, paper and other materials to non-porous surfaces, and can be easily cleaned from these surfaces when its mission is accomplished

There are many non-industrial uses for Texglue as an office paste, easily removed, leaving clean paper surfaces, for sealing packages, applying labels, posting bulletins It also can be applied as an anti-skid coating for rug bases, used to repair clothing and household furnishings, and to stop runs in hosiery

Non-flammable, with no objectionable odor, the cement can be stored in normal atmospheric temperatures, with avoidance of freezing temperatures or heat above 90 degrees

HI-JACKING THE ANT

Farmers Get Ants' Collection of Grass Seed

BY hi-jacking the harvest of buffalo-grass seed which red ants accumulate—probably as a source of winter feed—southern farmers and ranchers can sometimes gather a supply of seed at slight cost. One farmer in Bell County (Texas) got about 200 pounds of clean seed in

two days from ant hills in a pasture of native buffalo grass, says W J Neumann, in charge of a soil conservation project of the U S Department of Agriculture, near Temple, Texas

Soil Conservation Service men, who noticed that red ants collect buffalo-grass seeds and pile them around ant hills, were able to tell the farmer how to get seed for planting The seed material was swept together with a stiff push broom and then run through a commercial cleaner to separate the seed from soil, trash, and weed seeds

STEEL EATERS

Bacteria Thrive on Iron and Steel

THE discovery that certain bacteria living underground thrive on iron and steel pipes, causing annual rust and corrosion damages running into the millions, was announced at the convention of the American Gas Association by Raymond F Hadley of Philadelphia, electrical engineer of the Susquehanna Pipe Line Co

Known as anærobic bacteria because they live in an atmosphere devoid of oxygen, it has been found that they can survive for long periods of time when brought to the surface When magnified 850 times under the microscope, they appear in the shapes of coil spirals or curved rods They are particularly hardy Cultures have been grown from soil water taken from under ice They also have withstood temperatures as high as 176 degrees

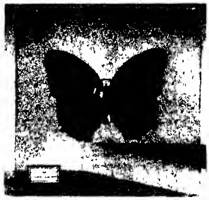
Once the bacteria have taken hold, the maximum life of a pipe is approximately seven to ten years The rate of corrosion under their attack is nearly three times that of other types, with the exception of carbon contact, stray electric currents, and concentrated acid

There are 450,000 miles of gas, oil, and water distribution systems in the United States, all of them susceptible to attack by the bacteria

BUGS IN PLASTICS

Transparent Sheets for New Mounting Method

FOR schools, laboratories, and camps, a new method for mounting biological specimens has recently been worked out, utilizing Monsanto cellulose acetate The mounts consist of two flat sheets with a hollow in the center of each. The specimen—butterfly, beetle, or other insect—is laid flat on one sheet with the body of the insect resting in the hollow Another sheet of the same size is placed over this Wings and limbs are between the sheets while the body rests in its cavity The two sheets are then



Oval center holds the body

cemented together The mount is now complete in a permanent, fully visible, and insect-proof arrangement

The mounts, known as the Schwarz Transparent Mounts, are being manufactured by the Frank Schwarz Studio, of St Louis, and distributed through the Central Scientific Company

APPLE JUICE

"Flash" Pasteurization Product Resembles Fresh Juice

THE "flash" pasteurization for preserving apple juice, developed by specialists at the State Experiment Station at Geneva, New York, provides a reliable and relatively simple method for use on the farm which will insure a product that is being well received by the public because of its close resemblance to freshly pressed apple juice

The essential features of the method include straining the juice carefully, heating it quickly to 170 degrees, Fahrenheit, and then putting the hot juice into bottles or cans without further treatment After standing for a few moments, the containers are quickly cooled The resulting product possesses much of the flavor and aroma of the freshly pressed juice and will keep indefinitely

"Until recently the only juice which could be prepared and preserved in the kitchen was tomato juice," say the Station specialists Now, however, "apple, cherry, grape, and many other fruit juices are used daily in the home. Im-

proved quality of preserved fruit juices has been made possible by development of methods of processing within the last few years These improved methods include continuous flash pasteurization with little or no loss of flavor, methods to exclude air from juices which formerly caused changes of flavor and deposit of undue amounts of sediment, and perfection of containers, both bottles and cans "

ART IN PLASTICS

Cold-Molding Material Makes Plaques

PLASTICS have found their way into art many times, yet usually there is some difficulty in handling them A new cold-molding plastic, made by the Monsanto Chemical Company, Plastics Division, obviates one of the most troublesome factors

Delicate modeling in plastic

in plastics molding—the use of heat Consequently, attractive, decorative plaques are now being cast from this material by W. L Stensgaard & Associates An accompanying illustration indicates the delicate modeling that is possible when using the material for casting in this manner

The cold-molding plastic is originally in the form of a liquid When this fluid is mixed with another and poured into molds, it hardens without heat into a durable, rigid plastic of warm color and pleasant texture.

SAWDUST STOVE

ON the West Coast there is being produced a new sawdust burner which reduces the sawdust to a gas which in turn is burned in the combustion chamber to give efficient heating. The sawdust is loaded into a hopper beside the stove. Heated by the flame above, the sawdust is converted into gas and a small amount of exhausted ash The sawdust smoulders on the grate, does not backfire, forms no creosote, and burns continuously so long as the hopper is kept filled Users have reported a fuel cost of 75 cents to $1 50 per month

GEOLOGIC MUD

New Technique Verifies Geologists' Claims

MUD deposits, 500 feet thick, on the deeper parts of the ocean floor, represent the accumulation of all geologic time, some 2,000,000,000 years Deep ocean deposits grow in thickness at the rate of two or three centimeters in from 5000 to 10,000 years A layer of sediment ten feet thick may represent a time interval of from 100,000 to 200,000 years

Dr Joseph A Cushman, director of the Cushman Research Laboratory at Sharon, Massachusetts, and a noted authority in marine geology, recently emphasized these facts as being of extreme importance in interpreting the geologic history of ocean muds, because wide ranges in geologic time are thus preserved in core samples of only a few feet in length

Vertical core samples 10 to 12 feet long have recently been collected from the deeper parts of the North Atlantic by the Piggot "gun," invented by Dr C S Piggot, of the Geophysical Laboratory of the Carnegie Institute of Washington Core samples obtained along the line of the Atlantic cable, from Newfoundland to Ireland, contained abundant fossil remains of tiny life forms, diatoms, and the snail-like foraminifera, which reflect climatic conditions prevalent at the time of deposition Warm water foraminifera, such as live now in the Gulf Stream, alternate with types characteristic of the Arctic These alternations of cold and warm types of foraminifera probably correspond to the known advances and retreats of the great ice sheet that once covered half of the North American continent

Even mud samples taken from the deepest portion of the Caribbean reflect the thickness of the great ice cap once lying far to the north. Cores from the Caribbean were described as showing definite zones of concentration of warm water foraminifera separated by zones in which they were absent

CAMERA ANGLES

Conducted by JACOB DESCHIN, A.R.P.S.

All Contrasts In One Paper

CHANGES in the color of the printing light when teamed with a suitably coated printing paper will afford a variety of tone contrasts in the one paper With this as a basis, the Defender people went to work to produce the paper and the method by which "complete contrast control" could be had in one grade of paper The result is Varigam (varied gamma), and the tests we have given it indicate the method to be both successful and useful

We made three separate tests on different occasions under the following conditions Darkroom illumination was by red safe-light, Varigam being sensitive to the ordinary printing safelights but not to red A negative of rather stronger than normal density was used in two of the tests and a normal strength negative in the other Development was in D-72 diluted 1 to 2 for two of the tests and in the Defender recommended 55-D in the third In the first two tests the bath was made up as usual and the whole batch run through in the one bath In the last test, with the 55-D, a separate, new bath was made up for *each* print to assure like developer conditions for each of the prints The temperature for each bath was held at 70 degrees and development was for 1½ minutes The enlarger light source was the popular "211"

With each package of Varigam paper, Defender supplies a yellow and a blue gelatin filter, together with a cardboard filter holder between which the filters are sandwiched by binding the edges with lantern-slide binding tape These filters are held under the enlarger lens or attached to the lens barrel with tape By varying the proportionate length of time during which each of the filters is held under the lens, thus coloring the light yellow or blue, as the case may be, different grades of contrasts are obtained on the one paper, blue light providing contrast—yellow light, softness.

A test strip is made in the usual way For this purpose the manufacturers recommend making a test with all blue light, but we have found it easier to judge proper printing time by cutting the exposure time in two, exposing half the time through the blue, half the time through the yellow filter The exposure learned through this test will be the same for all other combinations of the two filters In our test, the total exposure time was 14 seconds, and this remained the same for all the prints made from the same negative, the timing being distributed as follows 2 seconds for the blue, 12 seconds for the yellow, 4 seconds for the blue, 10 seconds for the yellow, and so on, plus 14-second exposures made entirely with yellow light and entirely with blue light

The resulting print contrasts gave a range from very soft gradation to very hard, with prints of distinctly different contrasts in between the two extremes, *from the same negative*

A more convenient method of altering the color of the light is the use of the Duraline Print-Control Filter Set prepared especially for Varigam paper by Harrison & Harrison, of Hollywood, California These are available in either the Standard Set, which contains ten filters with varying mixtures of the yellow and blue filters, or the Special Set, containing five filters The first provides ten degrees of contrast from YB1 (very soft) to

YB1

YB5

YB10 (extra hard), while the smaller set includes YB1, YB3, YB5, YB8, and YB10 The latter is quite satisfactory and if an additional filter may be required later on, it can be purchased separately With the set comes a dual snap holder, fitting a designated lens diameter The filters are easily snapped in and out In addition, a lock ring may be had for permanent attachment to the lens barrel

The other two tests were made with the Duraline filter set, and provided an amazing range of contrasts in the same printing time for each of the prints YB5 was used for making the test strip, after which all prints were made for the same time, the filters being snapped in and out successively in easy, routine fashion except that in the 55-D tests, a new bath was made up for each print This was for test purposes only, however, and is not necessary in normal working practice An indication of the range may be seen in the reproductions made, respectively, through the YB1, YB5, YB8, and YB10 Duraline filters If the engravings do justice to the originals, you will be able to judge of the results for yourself

We believe that in actual use, the average worker will eventually settle down to two or three, perhaps four filters or filter combinations (Incidentally, the Duraline filters must be used separately and not in combination with each other, since the varying combinations of blue and yellow are already incorporated in each of the filters) The other filters will be used for those special negatives requiring other than routine treatment

In actual use, the Varigam worker will forget all about the usual contrast designations and refer to them as YB contrasts instead In the beginning, he will make up a panel of prints from a negative of normal contrast and bind them into a folder or mount them over his printing table This panel he will use as a guide in selecting the proper filter to use with a particular negative If the negative is softer or harder than normal, he will make the proper allowance, just as he would with different grades of paper The advantage with Varigam, however, will be that a change in the filter rather than the paper is all that will be called for After the worker has become accustomed to processing Varigam, he will refer to contrasts not as normal or medium or hard, but as YB5, YB8, and so on And this, we feel, is a very definite and helpful advance in the art of printing

Movie-Making With a Purpose

IF you make a plan and try to stick to it, your movie-making activities will be the more valuable because they will build up to a definite goal rather than a miscellany of disconnected short lengths Moviemaker George Post, of New York City, who, incidentally, has been shooting Kodachrome exclusively ever since it appeared on the market, has a scheme that, to our mind, is worth imitating George has a rather wide range of interests, finding pleasure in shooting either flower closeups or the Cuban dancers at the World's Fair, scenic effects in the country or subjects in the intimacy of his own home But one thing he abhors, and that is mixing his interests on any one reel The plan he follows is this Whenever he comes across a subject he likes, he shoots as much film as he thinks necessary and spools it onto an empty 400-foot reel If his next subject is in another category, he spools it onto still another reel even though the first has only 50 feet on it When he has occasion to shoot another aspect of the first subject, he adds this footage onto that reel And thus he proceeds until the 400-foot reel of the one subject has been filled In this way he edits as he goes along, cutting off what he does not want before splicing it He tries when possible to get at

YB8

YB10

Fifth Annual Scientific American

AMATEUR PHOTOGRAPHY CONTEST

[For Complete Contest Rules, See Page 286, November 1940 Scientific American]

OVER $1200 IN PRIZES

36 PRIZES PLUS Three Special Awards

IN this year's contest, prints may be entered in any or all of the three groups listed below, in accordance with the rules In addition to the seven major prizes and five honorable mentions, there will be three SPECIAL AWARDS that will be accorded to the three outstanding photographs among the 36 prize winners *These special awards will be given in addition to the regular prizes that the pictures win*

DIVISIONS IN WHICH PRINTS MAY BE ENTERED

Division 1 Human interest, including camera studies of people, animals, and so on Portraits will be grouped in this division

Division 2. Landscapes, including all scenic views, seascapes, and so on.

Division 3. Action, including all types of photographs in which action is the predominating feature

THE PRIZES

1st. Three $125 LONGINES, Coronation Model, Solid Gold, Men's Wrist Watches.

2nd. Three $85 LONGINES, Presentation Model, Solid Gold, Men's Wrist Watches.

3rd. Three FEDERAL No. 246 Photo Enlargers (List Price $49.50).

4th. Three FEDERAL No. 345 Photo Enlargers (List Price $42.50).

5th. Three PIERCE CHRONOGRAPH Men's Wrist Watches (List Price $19.75).

6th. Three BERMAN-MEYERS Flash Guns complete with case (List price $15).

7th. Three FINK-ROSELIEVE Vaporators (List price $12.50)

HONORABLE MENTION

1st Three Fink-Roselieve "Hi-Spot" Hollywood type spotlights.

2nd. Three Mimosa Perkino developing tanks.

3rd. Three Raygram Wood-Chrome Tripods.

4th. Three Fink-Roselieve Audible Timers.

5th. Three Fink-Roselieve Satin-Chrome Range Finders.

THREE SPECIAL AWARDS!

Winning pictures in the three divisions will be grouped and judged further to determine which three of them shall be considered as the best in the entire contest To the contestants who entered these three photographs will be presented the following special awards

1st. One No. 715 Weston Exposure Meter (List price $24.)
2nd. One No. 650 Weston Exposure Meter (List price $19.95.)
3rd. One No. 850 Weston Exposure Meter (List price $15.50.)

THE JUDGES

McClelland Barclay, artist
Ivan Dmitri, artist and photographer
T J Maloney, editor of U S. Camera
Robert Yarnall Richie, photographer

Address all Entries to

Photograph Contest Editor, Scientific American

24 West 40th Street New York, N. Y.

least 400 feet of any one subject he tackles, though the period between the first shooting and the last may be a year.

Spiral Binding

YOU can now bind your own pictures in the same way the big annuals do. Select a group of your best shots, preferably centering around a single subject—the baby, for example—mount them on thin cardboards or use double-weight prints unmounted, and send them along to a firm that makes a specialty of this service. You must also provide a front and a back cover, which may be heavy cardboard of a desired color. It is recommended that 25 double-weight prints should be the maximum selected for any one book; otherwise, the books become too bulky and awkward to use Prints should not be larger than 8 by 10 inches The charge is only 15 cents for each book. The firm is Spiral Bindings, 148 Lafayette Street, New York City, New York Mailing charges are extra

Local Boy Makes Good

A BORROWED camera, much enthusiasm and first-hand knowledge of the terpsichorean art, started 27-year-old Constantine, New York City dancer (he prefers to use this name just as he has done in his dance work), off in photography a little less than a year ago Unaccustomed as he was to the vagaries of the camera shutter and finder, he cut off heads, legs, et cetera, and wept afterwards at what he called his stupidity, although, as everybody knows, the name for that is inexperience

In time, however, he was able to get the dancing figures intact on the film and to make creditable prints As he gained proficiency, confidence came along too, until the day came when he felt he was good enough to deserve a camera of his own. To make a long story short, he now has professional equipment, including a

7th Symphony of Beethoven

From the prompter's box

miniature camera and the Speed Graphic, using the latter for flash work almost exclusively, and has assumed the mantle of dance photographer.

The best part of our story is that Constantine did so well that the Ballet Russe dancers permitted him to come backstage for posed flash shots and work from the prompter's box with a miniature camera during the performance. He used the Contax in the latter vantage point and was able to get very good stills of action at 1/50 second with the $f/1.2$ Sonnar lens wide open. The pictures he made on these occasions turned out so successfully that the Kamin Gallery in New York City staged a one-man public exhibition of a selection of his best pictures Specialization in the one field he knew particularly well is undoubtedly the reason for Constantine's sudden rise to fame

Printing-In Clouds

We recently had occasion to print clouds into a bald sky, yet retain a sharp outline of a projecting figure in the foreground The job was accomplished in a rather simple manner Instead of the usual procedure of making an exact outline of the foreground and keeping it shaded with painstaking exactness while the clouds were being printed in, a rough outline was made for the foreground. The sky being dense, a straight projection of the negative provided the foreground subject image, with nothing but white paper where the clouds were to be.

This print was then placed in the developer. As soon as the image had come up very lightly, the print was removed from the developer bath and placed in the stop bath. It was then swabbed with cotton and placed on the easel again, with a blotter underneath to protect the easel. The cloud negative, which was previously strip-tested, was then projected while the foreground was shaded roughly with the rough outline mentioned. The exposure complete, the paper was re-

placed in the developer and left there for the full time, after which it was placed in the stop bath as usual, fixed and washed The result showed sharp image outlines with clouds printed into the bald sky, the whole giving the effect of having been made from a single negative—no break was to be seen anywhere

Light Makes the Picture

WITH great economy of light reflections, with only the salient points high-lighted and the rest in semi or complete darkness, the accompanying illustration of the outdoor musician was made at night outdoors by the light of a few small ceiling

"Night Concert"

bulbs Shooting from street level up to the band-stand, the exposure was 1/10 second at the full opening of the Tessar $f/3.5$ The light outlines the instrument in just the right places, providing just enough high-lighting for the purpose and no more Vibration of the instrument is apparent in the outline high-lights, thus affording an impression of a tuba (or whaddya call it) in full blast

Touring Exhibit Proposed

FEELING that some method is in order for giving impetus and assistance to local photographic contests, Albert Greenfield made the following proposal in a recent issue of the *New York World-Telegram* " to formulate plans for a traveling exhibit of photographic equipment, combined with local photographic contests under the auspices of a grand council comprised of representatives of every organized trade association in the photographic field "

"Why forget about the amateur photographers?" asks Mr Greenfield "They are the ones to see and inform about new equipment, and in their interest lies the market of the photographic industry

"The traveling exhibit that I have in mind could start in New York City, go to Philadelphia, then to Boston and

BOOKS—————BOOKS

for

Amateur Photographers

So You Want to Take Better Pictures, by A. P. Peck *A friendly, face-to-face chat with the camera owner who has his developing and printing done at the photo shops, yet wants to know enough about his camera and its uses to enable him intelligently to utilize it to best advantage Over 200 pages, dozens of illustrations. $2 10*

New Ways in Photography, *by Jacob Deschin* Eminently practical from every point of view, this new book contains nothing of theory and nothing that the advanced amateur photographer will not find valuable in one way or another It covers the whole range of amateur photography, discussing such things as trick photography, photomurals, retouching, infra-red, and a number of other subdivisions that will not be found elsewhere in as clear and concise a manner $2.85.

Universal Photo Almanac and Market Guide *How when and what to photograph in order to make money with your camera, where to sell different types of prints $1 00.*

Synchroflash Photography, *by Willard D Morgan* Flashlight bulbs, as sole and as supplementary light sources for photography Equipment and how to use it $2 10

Photographic Chemicals and Solutions, by J. I. Crabtree and G E. Matthews *Written in non technical language so that the book may be read and understood by all photographic workers $4.10*

The Boys' Book of Photography, *by Edwin Way Teale.* The complete gamut of photography from history to modern practice Essentially practical for boys both young and old $2 10

Photography By Infrared, by Walter Clark, F R P.S. *Accurate technical information on the whole subject of the title. How to obtain the best results $5.10.*

Photographing in Color. *by Paul Outerbridge, Jr.* A thoroughly practical guide for the perplexed color photographer, either rank beginner or advanced amateur. Included are 16 full-page, four-color reproductions $4.95.

Prices Quoted Include Postage

We Can Supply Any Photographic Book in Print

Scientific American

24 West 40th Street New York City

BOOKS—————BOOKS

to every important city in the East This exhibit would then cover every important city in the South and Midwest, and eventually reach the West Coast After a complete tour of the country has been made, a new revised show would be organized again to tour the country"

Sounds swell, Al When do we start?

For Ferrotypers

If you have been having trouble ferrotyping your glossy prints on chrome-plated tins, check over your procedure and see if the following may help you to get better results After the prints have been washed, rinse them in warm water before laying them down on the warm-water washed tin. Pass a rubber squeegee over the backs several times, length-wise and cross-wise Then sponge over the back with a squeezed viscose sponge, making particularly sure that all water has been forced out at the edges of the print, as well as from the entire surface Incidentally, single-weight glossy prints are easier to ferrotype than double-weight paper

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WHAT'S NEW

In Photographic Equipment

Solar Copying Stand ($17 50) For use with any type camera with suitable bellows extension or supplementary copying lens Adjustable camera supporting arm permits camera to be brought down within eight to ten inches from baseboard, depending upon size of camera used At top distance camera is about three feet from board Sliding rod, hexagonal shape, permits in-and-out adjustment over eight-inch range, making possible to set camera at any of six different angles Complete assembly includes standard Solar baseboard, upright standard, and adjustable camera supporting arm

F-R Adjusto Print Press ($3 95) Accommodates 100 prints between blotters Heavy, all-steel construction designed to eliminate warping Dimensions 12 by 15 inches, takes prints up to and including 11 by 14 Top section of press fastened to bottom section with two locking lugs Four rubber snubbers on base prevent scratching of any surface where press may be placed

Agfa Viking Cameras ($13 75 to $18 75) Equipped with $f/6.3$ or $f/7.7$ anastigmat lens Take eight pictures 2¼ by 3¼ or 2½ by 4¼ inches. Standard equipment includes built-in, body shutter release; optical eye-level and reflecting, waist-level finders; hinged back and easy-loading spool carriers; self-

erecting front. Both models focus from 5 feet to infinity, shutter speeds, 1/25, 1/50, and 1/100 second, bulb and time exposures

TIMETER ($24 85)· Synchronized exposure meter and automatic timer for use in enlarging Electric-controlled light measurement eliminates use of test strips, providing indication for correct grade of paper to use for given negative Timeter provides precision control, accurate readings,

synchronous calibration, automatic timing, complete paper speed chart of all papers. Exposure time range 3 to 120 seconds Light meter range 1/100 to 4 foot candles Paper speed range 0 to 100 Timeter rating. Plug meter into 110 volts, 60 cycles AC electric socket

GEM KOLOR CHROME ($1 25) Developer-toner permitting toning simultaneously with development Available in five essential colors sepia, blue, green, magenta, yellow. Kit includes three units. developer, toner, fixer. Many shades and hues possible by mixing colors in various combinations Any print already made in black-and-white may also be toned Can be used for toning various portions of print in different colors Colors controlled locally on finished print Permits making color transparencies from regular black-and-white negatives.

FOTOFOAM ($ 75) Cleansing agent for photographic use Cleans films and plates. Drying time speeded 25% to 40% Aid in retouching, reducing, intensifying, toning May be used to clean tanks, trays, glassware

FLUOR-O-PHOTO ($102 50 for light and stand, less tubes) Bardwell & McAlister eight-tube fluorescent light, Type 15. Tubes 24" by 1½", 20-watt, either white or daylight type. Individual starting switches replaceable by using small friction socket furnished with each light. Normal height range 5 feet to 9 feet. Special counterbalance stand permits easy raising or lowering. Accessories available for unit include low arm adapter called "Knee Bracket." With this, light may be operated from as low as two feet to height of five feet. Wing shades, mounted on sides, also available.

AGFA INFRA-RED FILM. Now available, in addition to 35mm, in three popular roll-film sizes—A8 (same as 127) $ 40; PB20 (same as 620) $.45; B2

(same as 120) \$.45. With suitable filter is specially sensitive to deep red and infra-red regions of spectrum, recording blue skies in dark tones, and green foliage, light-colored buildings, white clouds and similar subject-matter in various tones from light gray to clean white. Requirements: bright sunlight and red or other blue-extinction filter for exposures, which average, with filter, 1/25 second at $f/5.6$ to $f/6.3$ Film is fine grain, has moderately brilliant gradation and effective type of anti-halo protection.

KODAK ELECTRIC TIMER (\$9.50): Sixty-minute timer for A.C. only Neatly designed die-cast case finished in smooth gray. Large dial with easy-to-read figures; minute and second hands.

FILMO FADER Designed for professional effects with amateur movie cameras Adjustable indicator visible in camera viewfinder shows when fades and wipes are completed. Fader said to be automatic; fits all makes of 8 and 16mm cameras and makes fade-ins, fade-outs, wipe-ons, wipe-offs, and, where camera is equipped to rewind film, transitional lap-dissolves Fader can be mounted at any angle to permit wipes to appear or disappear from any direction Fades made with rotating disk graduated from opaque black to clear sector, and back again to opaqueness

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THE ROUND TABLE

Questions Answered for the Amateur Photographer

Q **Can you supply a formula for writing over the numbers on glass graduates to make them more visible?—L. K.**

A An effective "ink" for writing on glass so that no matter how much water is passed over it, it will not be washed off, is the following:

Shellac, unbleached	4 drams
Alcohol (95%)	4 ounces
Borax	7 drams
Water	6 ounces

Then add 12 grains aniline (adding any desired color).

Q. **I don't understand why it should be necessary to make the labels referred to in your item on "Labels on Bottles," issue of August, 1940, out of photographic paper instead of ordinary paper of corresponding quality—for instance, high-grade bond writing paper.—H. Y.**

A. Fixed-out photographic paper is recommended in order to prevent streaking when the varnish is applied. Photographic papers are coated, or sized, with baryta in order to provide a hard surface for the emulsion to be spread upon evenly and without streakiness. The baryta fills the pores of the paper, like a sizing, and keeps the emulsion (or varnish, in the present instance) from sinking into the paper The baryta coating stays in the paper whether a photographic image is made or not; as a result, it provides a useful surface for the labeling method described.

Q. **On occasion, I like to take portraits at home or in the homes of friends, but almost invariably run across the problem of what to do for a plain background, which seems to be ideal. What is your suggestion for a good all-around portable background that can be rolled up and put away when not wanted?—N. L.**

A. A sheet of white muslin or other white cloth will provide the greatest utility inasmuch as a varied range of background tones can be provided by the way the light source is arranged Get some half-round molding and cut it the width of your background (four feet to six feet) Cut four lengths the same size. Sandwich one end of the cloth between two of the half-round strips, nailing them together, then do the same for the other end In use, the background is hung by a hook on a wall or tall piece of furniture, the molding at the lower end providing the weight to keep the background stretched taut, thus preventing folds and creases

Q. **What is the adhesive used for binding together two sheets of mounting board to prevent curling or to give increased thickness or weight?—D. M.**

A A stock batch of the following adhesive is made up for use as wanted Fourteen ounces of any good quality glue is dissolved in 26 ounces of water To this is added 1 ounce of a solution composed of one part of shellac in seven parts alcohol Keep stirring until the solution cools. One-half ounce of dextrine is now dissolved in 7 ounces of alcohol and 3 1/3 ounces of water Stir and place the vessel in warm water until the solution is complete The two solutions are then mixed and cooled For use, a small piece is cut off as wanted and liquefied by warming

Q. **I find that in using the dry mounting method, my prints start peeling off not long afterwards. Is there any cure-all for this situation?—F. N. H.**

A. First of all, as you probably know, the tissue must be tacked to the back of the print, and print and tissue trimmed together. Tacking should be done from the center outwards and not from the corners inwards. That is, run the iron in cross lines from top to bottom and across the back of the print, leaving the corners free. Lay the print in the appropriate position on the mount, overlay a sheet of paper and apply the iron from the center out. Move the iron very slowly, giving what experience must teach you is about the right timing to do the job effectively.

Conducted by A. D. RATHBONE, IV

INTEREST IN FIREARMS *is traditional with American men, fishing tackle is a requisite of one of the world's oldest occupations Scientific development of guns and tackle, in the use of which millions yearly find sport and recreation, fathers this monthly department which welcomes correspondence from readers*

For "Defense"!

"A WELL-REGULATED militia being necessary to the security of a free State, the right of the people to keep and bear arms shall not be infringed "—Article II of the 10 original amendments to the Constitution of the United States of America These first 10 amendments, known collectively as "The Bill of Rights," were proposed at the first session of the First Congress, meeting in New York City, September 25, 1789 After ratification by 10 of the 13 states, they were declared in force December 15, 1791

The exploration, settlement, and growth of the United States from the wilderness it was in 1791 to the nation it is in 1940 owes so much to "the right of the people to keep and bear arms" that the statement of that obligation needs no amplification Today, privately owned guns of that era of personal and territorial protection have been almost entirely replaced by what are known as "sporting arms" The nearly 7,000,000 American owners of these guns annually pay about $12,000,000 for hunting licenses and fees, close to $3,000,000 in Federal excise taxes on sporting arms and ammunition, better than $2,500,000 for Federal Migratory Bird Hunting stamps Practically every one of these dollars in this 15-million-dollar-a-year business is spent by Federal or State agencies for rehabilitation of American wildlife, which, despite misconception to the contrary, was eliminated, depleted, or endangered not by hunters, but by economic forces and activities that deprived wildlife of natural breeding and feeding grounds

As pointed out editorially on page 243 of the November issue, proponents of anti-firearms legislation have for years tried to curb "the right of the people to keep and bear arms," annually originating as many as 100 bills in state legislatures Had the last Congressional proposal passed, seven million licensed sportsmen and other private owners of arms would have (1) registered and paid a dollar fee for each gun owned or bought in the future, (2) been "mugged" and fingerprinted, (3) paid a transfer fee if a gun was sold Now, once again, this old bogey threatens, but behind its mask of "national defense" we find the same glaring and idiotic fallacy of expecting subversively-minded people to step forward and register guns held for lawless purposes

Registration of guns owned by citizens of the United States is unnecessary as a national defense measure. It cannot conceivably achieve the purpose claimed by its sponsors, because banditry and homicide, Nazism and Communism are practiced not by the gun, but by the man behind it As he is notoriously known to have no use for this country's laws as they exist today, why should we believe he would respect a new one? To attempt to eliminate military weapons from subversive elements through registration of all arms, including your own sporting rifle and shotgun, would be silly, impracticable, and impossible on the face of it, but such action might result in untold injury to national defense If, as a further "defense" measure, all registered guns were to be impounded—far from an hysterical thought—we would have the ridiculous and pitiable picture of a nation that had disarmed its law-abiding citizens and which had left the lawless ones in our communities fully equipped with weapons

If, as is generally agreed, the recent Federalizing of the National Guard, and the conscription and calling of men into training indicates "A well-regulated militia being necessary to the security of a free state," then the rest of those priceless words are as applicable and as potent today as they were when written into our Constitution 150 years ago, and, if straight-thinking people have their way, "the right of the people to keep and bear arms shall not be infringed"

On The Solunar Theory

LAST summer we fished a certain lake carefully and consistently from August 21 to September 1 On the 21st we were throwing back small-mouth black bass because they were too plentiful From August 28 to September 1, we frequently repeated that process, but from the 21st to the 28th we had very little action, and now, perhaps, we've found out why We've just read John Alden Knight's newest book, "The Theory and Technique of Fresh Water Angling," and have not only found it packed with sound knowledge of the elements of angling, but, what is more pertinent to our spotty fishing experience, the book also contains chapters on "Habits of Fresh Water Fish" and "The Solunar Theory," the latter having been advanced by Mr. Knight some years ago.

Whether you attempt to prognosti-

cate angling luck by the tides, wind direction, moon phase, color of sunset, leaf action, bird songs, or other pet theories, or just "go fishin'" you will be interested in Knight's statement that, "unquestionably the phases of the moon affect the lives and habits of all living things" Testing this thought in practice, the author established a system which worked quite well for several days each month, but the occurrence of regular lapses led him to investigate further. Following the theory of ocean fishermen that tides bring food to fish, thus establishing feeding periods, Knight felt there might be connection between feeding cycles of fresh and salt water fish This brought him to causes of the tides and consideration of sun as well as moon phases "Finally," he writes, "by discarding the tide tables and doing my own calculation of the actuating force by charting the resultant of the solar and lunar forces as applied to the earth, I found the schedule could be made fairly accurate In so doing, the name 'Solunar' was coined —purely as a convenient term for describing the force in question Thus was the Solunar Theory born"

Perhaps you've seen or used Knight's Solunar Tables, first published in 1935, and if so, you've formed your own conclusions Possibly you've said, "Pooey!" to the whole thing The fact remains that on checking this year's Solunar Tables, which we did *not* have along last August, with the meticulous record of wind, weather, water and air temperatures, and time of fishing, which we did keep, we found that the Solunar periods had closely coincided with our moments of best fishing Perhaps it's still "Pooey!" in your estimation, but the constant application of science to the unknown in angling is slowly teaching us more about fish propagation, culture and habits, fishing tackle and how to use it to best advantage Surely, we'd all be Methuselahs if we lived long enough to know all there is to know about fishing!

They Won Guns

FROM the amazing number of 18,000 entries in the O F Mossberg & Sons, Inc, "Rifle Name Contest," (May, 1940, Scientific American) the judges selected "Armsworth," submitted by Albert Campbell, of Richardson Park, Delaware, as prize-

"Armsworth"

winning name for the new Mossberg "M" model rifles. Second prize was awarded to Emery R. Fry, Oregon, Illinois, for submission of "Moss-K-Teer," and third award went to George H. Webster, Sheffield, Alabama, for suggestion of "Carbineer," a name also sent in by other entrants. Decision in the last instance was based on the best 20-word statement submitted with the entry. Each winner was awarded a cash prize and his choice of the three "M" rifles, and each chose the automatic, Model 51 M Consolation prizes were given to 15 other contestants, and after it was all over, Iver Mossberg was so gratified at the wide-spread interest shown that he remarked: "Makes you want to work even harder to give 'em the biggest gun value in the world." We still have a few catalogs showing the "M" models and other Mossberg products Want one?

"Fender Hunters'" Delight

WE once knew an old-time Michigan woodsman who had his own term for fireside hunters He called them "fender hunters" because they never took their feet off the fireplace fender and spent most of the day and night arguing about whether wolves really attack people, how high and how fast do ducks and geese fly, are white-tailed deer frightened by a hunter's campfire, and a lot of other problematic things in woodcraft The answers to these and other famous questions will be found in a colorful, informative booklet by Goodrich Division of Hood Rubber Company It is called "Campfire Debates" and has a companion publication entitled "How Smart Are Dumb Animals?" We've a supply of each and will be glad to send them to you

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POT SHOTS
At Things New

REMINGTON ARMS COMPANY answers demands of increasing army of big game hunters for autoloading rifle in caliber approaching ballistics of popular 30 Springfield '06 by producing modernized Model 81 "Woodsmaster" in 300 Savage caliber This combination of recent type, rapid firing

"Woodsmaster"

rifle with cartridge of 2660 fps velocity, low trajectory—three inches at 200 yards—is highly effective, produces splendid accuracy and is under shooter's control at all times because trigger must be pulled and released for each shot In addition to 300 Savage caliber, "Woodsmaster" is available in .30 Rem, 32 Rem., and .35 Rem. calibers.

MERSHON COMPANY, INC, formerly Fray-Mershon, Inc., depicts scores of gunner and angler necessities in their new 1941 catalog In addition to an excellent line of firearms and accessories, equipment for archery,

Here it is! We termed it a "magnificent publication." (See article on page 284, November)

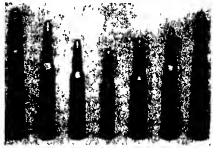
• • •

camping, and winter sports is shown. Of special interest to fishermen will be Mershon's "Reel-Fold" line dryer, which conveniently clamps anywhere, dries two or more lines simultaneously, reverses lines end for end, coils them to any desired circumference, is rust-proof and packs into a 1½ by 10½-inch unit for tackle box storage.

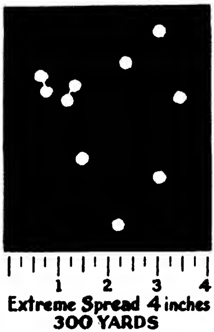
ABERCROMBIE & FITCH, in presenting their newest and customarily "tops" catalog, perfectly express our feelings about guns when they inscribe the first page "We like to believe that a fine sporting gun does more for a man than merely bring game to bag. A gun is the link between men and the out-of-doors. It is the lodestone that draws sportsmen together It is a symbol of the woods, of relaxation around campfires, of companions who have shared adventures A good and well-used gun stands for the finest moments in a sportsman's life" The book's 136 pages are attractively covered, profusely illustrated, completely indexed, and contain every conceivable need for the gunner

J. STEVENS ARMS COMPANY'S newest shotgun innovation is Model 240, a 410 bore over-under, with 26-inch close-choked barrels, weighing 6½ pounds, chambered for the 3-inch 410 shell and selling at astonishingly low price of $15.10. Like Stevens' extremely popular model 530M side-by-side double gun, which came out a year ago, the new over-under has stock and fore-end of Tenite, that hard, tough plastic which will not swell, split, warp, or crack and which so perfectly resembles knurled walnut.

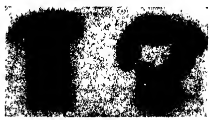
WESTERN CARTRIDGE COMPANY'S recently announced Silvertip bullets, made in 18 calibers, establishes new high in hunting ammunition accuracy. Target shown was made with .30-'06, 180 grain Silvertip fired from machine rest under normal outdoor conditions. New principle of scientific construction produces remarkable accuracy at all hunting ranges. The Silvertip has a double jacket, the outer Lubaloy metal protecting the rifle bore, the inner of nickel silver encasing the point and soft lead core nearly to the base Differing from ordinary soft nose or hollow point bullet which spreads on contact, Silvertip's light casing delays expansion, permitting bullet to penetrate hair, hide, tough tissue without loss of bullet weight. After penetration, bullet rapidly ex-



The Silvertip cartridges . . .



. . . a 300-yard target . . .



. . . and bullet expansion

pands to about twice original diameter, Lubaloy jacket then curls back, forming supporting shoulder for expanded core. Careful determination of proper thickness of tip casing and amount of exposure of tip result in correct penetration and expansion at all ranges.

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THE BIRTH AND DEATH OF THE SUN

By George Gamow, Professor Theoretical Physics, George Washington University

DEDICATED to Professor Henry Norris Russell, this book is a popularization, as far as its abstruse subjects can be popularized, of the study of sub-atomic energy and stellar evolution. Astrophysics being an extension of physics beyond the laboratory (the two in actual fact are one), a large part of this book deals with the anatomy of atoms as such, the transmutation of elements, and sub-atomic energy The remainder—130 pages—might almost be called a popular astrophysics but it isn't "fluffy stuff," for all its popularization, nor yet is it "deep stuff." A serious book. (238 pages, 4¾ by 8¼ inches, 76 illustrations.)—$3.10 postpaid.—*A G. I.*

THE THEORY AND TECHNIQUE OF FRESH WATER ANGLING

By John Alden Knight

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By John B. Walker

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By George Ross Wells, Professor of Psychology, Hartford Seminary Foundation

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—OUR BOOK CORNER—

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A Monthly Department for the Amateur Telescope Maker

Conducted by ALBERT G. INGALLS

Boston, traditional home of the bean and the cod, is said to have slipped somewhat in beans, but in telescope making it has come up a long way since the organization, some years ago, of the enterprising Amateur Telescope Makers of Boston Leading spirit and first president of this organization has been W H Hargbol, 600 Beech St, Roslindale, Mass., (a postal station in Boston), and this column has too long been remiss about describing Hargbol's telescopes, three of which are shown in Figures 1, 2, and 3

Hargbol began, some years ago, the same as any typical amateur, by making a modest first telescope, and the rest simply followed as usual by a kind of internal compulsion· he has now worked, he says when questioned, on 125 to 200 telescopes for himself and others, and he instructs in formal university extension classes at Harvard and at the Franklin Union Technical Institute. He does all his mirror work by hand

Figure 1 is an 8", $f/6.5$ portable, with brass-covered galvanized tube

Figure 2 is a 10", $f/6$ 2 portable, with a tube of 3/32" Bakelite This is attached to the declination axis spider casting by means of two long rails These in turn are attached to two end brackets screwed respectively to the cell and to the central tube ring, so that the tube itself does not touch any of these except the ring and cell.

As Figure 2 shows, nearly half of the total tube length lies above the central ring, and this part may be rotated, the ring shown being divided in two parts Hargbol was warned in advance that such a long rotated tube end usually is difficult to maintain in accurate geometrical relation to the lower end, and causes adjustment troubles He therefore saw to it that the rings received very fine machine work, and found that the extra pains

Figure 1: **Hargbol I, 8"**

taken paid well, since the arrangement has proved good. Both rings are essentially L-shaped in cross-section, the lower one having an inner, upward projection. In addition, there are six external clamps, held on by screws into the lower ring, and, between the retaining projection and the clamps, the tube end does stay where it is told to stay

The polar axis is a solid piece of 1¾" steel, the declination axis 1½". Both have thrust ball bearings.

Figure 3 is a 12½" reflector with an $f/5$ Pyrex mirror Figure 4 is its focogram with very good shadows— for a short focal-ratio mirror Since there is perennial evidence that, despite warnings in the handbook, "Amateur Telescope Making," many beginners, not to speak of some who are not beginners, are satisfied to judge a mirror merely by visual inspection of the shadows, without actually

Figure 2: **Hargbol II, 10"**

measuring zones, and since this practice is very likely to lead to the production of over-corrected mirrors, some of them grossly so, readers are warned not to take away with them as a mental standard of shadow *density*, for application to the average mirror, the shadows of this focogram The shadows are right for this $f/5$ mirror but would be wrong for the average mirror with medium focal ratio Ellison emphatically points this out in "ATM," page 96 The mere *distribution* of lights and shadows on a mirror is not an adequate criterion of the radii of its respective parts This point is twice labored here for the benefit of the increased number of younger men — 18 to 22 — who are known to be taking up telescope making today. We have evidence that good mirrors are becoming fewer and far-

Figure 3: **Hargbol and III, 12"**

ther between, and some think the two facts are related. Middle-aged men are more tenacious and patient, and less inclined to be in a big hurry, and therefore they turn out better jobs Hence, measure zones—don't merely hope, even if the shadow map looks right. Looks are deceptive; mirrors, too, wear make-up And refigure, even if it hurts, when the map looks fine but the curve proves to be too deep. On an $f/8$ the shadows will be much greyer and thinner than those of Figure 4.

The 2" polar axis shaft of Hargbol's 12" telescope is mounted on a tapered roller bearing at top and a ball bearing at bottom, the bearings packed in grease and provided with dust covers The photograph shows the wide, thin fins cast integral with the declination axis casting, making it very stiff— practically as stiff as it would be if the entire envelope were solid, yet much lighter Hargbol made the patterns and core box and will be glad to pass along to any interested amateur the experience he gained in doing this part of the job.

The triangular spider at top of the

Figure 4: **Focogram of III**

declination axis appears in Figure 3 to have an open center, which would mean weakness, but actually it is a casting having a strong central web

The base casting of this telescope weighs 40 pounds, the declination casting 25 pounds, the tube base weighs 15 pounds, and the counterweight 56 pounds.

TRAUB, not Pope, as stated, was the maker of the observatory dome shown in the October number on page 234. Pope writes to say that he doesn't want credit for another man's work Ours was the error.

TED WATTERSON, official photographer at Palomar Observatory, Palomar Mt (Yes, it's now a United States post office), Calif, made the two photographs of the 200" telescope shown in Figures 5 and 6

Figure 5 shows the upper end of the tube, 20'3" in diameter, cuddled down into the big horseshoe, 46' in diameter, which constitutes the north bearing, and pointing toward the celestial pole The two oil pads on which the horseshoe floats as it rotates show at left and right Figure 6 is a close-up of one of these unique pads

Figure 5: The 200" telescope

Figure 6: Oil pad bearing

Oil is constantly pumped into these pads under pressure. This cuts the torque required to rotate the telescope from 22,000 pound-feet as calculated for roller bearings, to 50 pound-feet. The oil comes up through holes. The pads are covered with babbit metal. The entire pad rests on a knife-edge and each half rests on a spherical seat.

The horseshoe (split ring) bearing is a Porter contribution.

Bubbles in Pyrex mirror disks cannot be entirely avoided, because Pyrex remains so viscous at temperatures to which it can be raised in melting (about 2800° F.) that the smaller ones haven't enough flotation power to push upward to the top and escape The manufacturers therefore have to cull the disks over, throwing out the more bubbley ones Recently, we learn, they have been culling these disks more closely.

If, when the disk is ground, the grinding intersects bubbles, a thin edge is usually created and any fragments breaking loose may scratch the glass Different amateurs have used various methods of anticipating these troubles and heading them off in time (when the first break-through occurs) by reaming them out Our file on this subject shows that M J Ireland, Dearborn, Mich, used a twist drill and abrasive grains Edward P Woodcock, Long Beach, Calif, used the rear end of a twist drill or a rat-tail file with abrasive grains Lew Lojas, New York, put a round-head screw in a drill brace and similarly used abrasive grains Woodcock further commented "Because the bubbles do not materially affect the surface optically, they can do little harm if left alone, provided the edge looks safe from chipping, as in cases where they lie perpendicular to the face"

H H Selby, of California, after having some perplexing difficulty with mysterious scratches, found bubbles to be the cause "After each wet," he says, therefore, "I dried the surface, scrubbed the bubbles hard with a toothbrush and shellac and, after ten minutes, scraped off the excess During this scrubbing, the brush broke the thin edges of the glass and the shellac sealed in the fragments"

Invention of the telescope is generally credited to Jan Lippershay, who in 1608 arranged a convex lens in front of a concave Bell, in "The Telescope," says Lippershay's telescope was far, however, from being an astronomical instrument In the following spring Galileo heard rumor of this instrument that made distant objects seem near, sat down and, in one evening, independently figured out an arrangement of lenses which would accomplish this end and it magnified three diameters Galileo, as Bell states, soon developed this crude beginning into a real instrument of research, magnifying 32 diameters This telescope is on display in a museum in Florence, behind glass, and your scribe in 1928 slipped the guard there 50 cents to open the case and place a step-ladder before it, so he could climb up close for a little veneration at this fane Main credit for the invention of the astronomical telescope rightly goes to Galileo, he (1) really made something of it and (2) did important research with it Moreover, Galileo, not a meek man, fought for his discoveries and gave them publicity, when he could have kept out of hot water merely by being tactful and agreeable. This probably had very much to do with their survival.

While visiting the exhibition of the scientific achievements of Leonardo da Vinci, described on page 332, with Russell Porter, your scribe stumbled on the two grinding machines shown in Figures 7 and 8 If Galileo, who lived from 1564 to 1642, gave us the first astronomical telescope, what was Leonardo da Vinci, who lived from 1452 to 1519, or roughly a whole century earlier, doing with these designs? Porter and Ingalls looked at one another and remarked, "What does it mean?" Were the histories of science then all mistaken? "Better look into that," said Porter, and took a train for California

The machine in Figure 7 was accompanied by a label stating that it was "a model of a hand-operated machine for grinding a concave lens for a telescope or other instruments" The radius beam on the one in Figure 8 bore the label, in Italian, "Leonardo made this up to 12 meters long" The first machine has a stub lever beneath the bed-plate, with a notch on which a weight could be hung to hold the disk against the grinding wheel, just as it is shown in the photograph The remainder of the mechanism is obvious (While the lantern gear may look antique, be it remembered that

Figure 7 **Design by L. da Vinci**

in Leonardo's time a man couldn't simply turn to the Chicago or Boston Gear Works catalog and select a gear; he had to make his own Moreover, some of these old gears were not so inefficient as one might think) The machine in Figure 8 is crank-operated (crank at right-hand end removed in photo) and causes the convex metal sector on the nearer end of the long radius beam to traverse the disk. Evidently the crank man must go into reverse after each two or three turns

At the offices of the New York Museum of Science and Industry, it was learned that Prof. Georgio Nicodemi, Director of the Department of Fine Arts of the Common of Milan, also Director of Museums in Sforza Castle and an outstanding authority and

writer on Leonardo, had accompanied the exhibition to New York When hunted up and questioned, through an interpreter, he said that the question of Leonardo's possible priority of invention of the telescope had been the subject of recent discussion in Italy, and he kindly offered to prepare a note summarizing these discussions

It appears that Prof Claudio Argentieri has discovered some pages of Leonardo's original notes which have not yet been published "The most surprising of Argentieri's observations," Prof Nicodemi writes, "are those concerning the telescope On folio 25r, of Codice F, which is now in the Institute of France, in Paris, Argentieri noticed, under a figure of a large tube mounted on a stand, the

Figure 8 **Another L. da V. design**

words, 'This eyeglass of crystal must be flawless and very clear, and is to be thin in the center' The note obviously refers to a negative lens Other notes on the same sheet leave no doubt that Leonardo wished to design a magnifying instrument, and still others explain that one lens was to be plano-convex Brief writings in Codex E and Codex A [exact references available to any interested reader—Ed] indicate that Leonardo intended his telescope for astronomical applications "

Prof Nicodemi goes on to state that Leonardo improved his telescope by using a concave mirror with a catacaustic curve but without an eyepiece The machines shown in Figure 8 might have been used for roughing out such a mirror

Since Leonardo couldn't have used a concave lens alone as a telescope, though he could use a convex, it seems possible that he had used the two in combination—that is, the arrangement now known as "Galilean," apparently he also used a concave mirror without eyepiece. But in any case, he omitted to publish an account of his telescopes, thus losing credit if this were his due, incidentally, delaying availability of the telescope to the world for about a century

Whether this would have opened up man's cramped horizons in Leonardo's times, as it later did in Galileo's, and accelerated the Age of Science as much, is, of course, a question Our guess is that, today, the 200" telescope would be a back number

Patent, Trade Mark, and Related Legal Proceedings That May Have a Direct Effect on Your Business

By ORSON D. MUNN, Litt.B., L.L.B., Sc.D.

New York Bar
Editor, Scientific American

Labor Labels

JUDGE THOMAS GLYNN WALKER of the Federal Court in New Jersey, in a decision of unusual interest, has restrained the imitation of the label of a labor union.

The suit was filed by a printing-trade union against a corporation bearing the words "Printers Union" in its corporate name The Court found that the plaintiff was a voluntary association of working men; that it had adopted a distinctive label which was registered as a trade mark for stationery and that it permitted printing establishments employing members of the union to place the union trade mark or label upon its products.

The Court also found that the defendant, despite the fact that its corporate name included the words "Printers Union," was organized and supported by non-union printing establishments; that it had adopted a label which simulated in many respects the union label, and that in one instance the label of the defendant had been mistaken for the label of the printing trade union The Court found that the simulation of the label constituted trade-mark infringement and that the defendant's entire course of conduct constituted unfair competition.

In reaching its decision the Court pointed out that the defendant had evidenced bad faith by seeking to represent itself as a trade union when, as a matter of fact, it was an organization supported by non-union printing establishments. The Court then pointed out that the defendant, having represented itself as a trade union, "then went a step further and sought to convey the impression that its label was in fact the label of" the plaintiff. It concluded that the use of the word "Union" in the defendant's corporate title, the use of a union label, the use of the words "Union label" and the use of a label deceptively similar to the plaintiff's label, "are with many of the other things herein shown by the record, the parts which, when put together, form the finished mosaic whereby the fraudulent design of the defendant is clearly spelled out."

Non-Exclusive

A NON-EXCLUSIVE licensee under a patent cannot bring suit for infringement of the patent.

This question arose in a rather unusual manner in a Federal Court suit for patent infringement. After the suit was filed, the plaintiff discovered that he did not own the patent but merely held a non-exclusive license under the patent and made a motion to dismiss the suit.

The defendant had filed a counter claim in the suit asking for a declaratory judgment, finding the patent invalid and not infringed, and sought to prevent the dismissal of the suit for the reason that he had incurred a great deal of expense in preparing for the defense thereof.

The Court found, however, that since the plaintiff was merely a non-exclusive licensee, there was no legal controversy between the parties and dismissed the suit

Technical

WE have previously pointed out that our copyright law is highly technical and requires literal compliance therewith No portion of the law is more technical than that dealing with the notice of copyright which must be affixed to the copyrighted work This is exemplified in a recent suit involving copyrighted advertisements

An advertising agency prepared a series of advertisements to be used by banks The agency sold the advertisements to subscribing banks who reproduced the advertisements in newspapers and other periodicals. The agency had bound the advertisements in a volume which was copyrighted as a book. Thereafter a bank reproduced several of the advertisements without license or permission of the agency and suit was brought against the bank for copyright infringement

One of the defenses raised by the bank was that the agency had failed to affix to each copy of the advertisements, which were reproduced and sold, the proper copyright notice required by law.

The copyright law provides in part that every copy of the copyrighted work must contain the required notice and failure to include the notice results in abandonment of the copyright The law also provides that in the case of a book the required notice shall consist of the word "copyright" or the abbreviation "copr" followed by the date and the name of the copyright proprietor.

In the case of certain works such as prints and pictorial illustrations the law provides that the notice may consist of the letter "C" enclosed within a circle and followed by the initials of the copyright proprietor.

The Court found that the bound volume of advertisements contained the proper notice required by the copyright law for books However, in actual practice, the advertisements were not published in a volume as a unit, but were separately reproduced and published. The only notice appearing on the individual advertisement was the letter "C" enclosed within a circle together with the abbreviation of the advertising agency and this was so small as not to be legible without the aid of a microscope or glass.

The Court held that this notice did not comply with the requirements of the statute and concluded that the copyright had been abandoned. It was pointed out by the Court that the individual advertisements might well be considered as prints or pictorial illustrations and could have been copyrighted as such. If they had been so copyrighted, the form of the notice would have been proper Since, however, they had been bound together in a volume and had been copyrighted as a book, compliance with the statute required that the notice should consist of the word "copyright" or the abbreviation "copr" followed by the date and the name of the copyright proprietor

Rubber Sandpaper

A FLEXIBLE abrasive article similar to sandpaper, comprising abrasive grits or particles, held in a bond of a rubber isomer, was held to be patentable by a Federal Court

The inventor of the article had applied for a patent and the Patent Office had refused to grant the patent on the grounds that there was no invention involved because prior patents showed it to be old to hold abrasive grits in a bond of raw or vulcanized rubber The substitution of a rubber isomer bond for the rubber bonds shown in the prior patents, was not considered by the Patent Office to be patentable

The inventor filed suit in a Federal Court against the Commissioner of Patents and the Court held that the invention was patentable and ordered the granting of a patent In its decision the Court pointed out that the advantage of using a flexible rubber bond in an abrasive article such as sandpaper had long been recognized. However, prior to the invention under consideration, no satisfactory rubber bond had been developed. Some of the difficulties encountered were that a sufficient bond between the rubber and abrasive particles could not be obtained, and ordinary rubber had a tendency to clog or to become gummy in use.

The Court found that the use of a bond made of a rubber isomer overcame these difficulties and for the first time solved the problem of providing an abrasive article similar to sandpaper in which the abrasive particles were held in position by a satisfactory rubber bond.

(The Editor will appreciate it if you will mention Scientific American when writing for any of the publications listed below.)

HOW TO MAKE TALKING PICTURES AT HOME is a completely illustrated description of the Presto Syncro-Sound recorder and its operation. With the equipment described, any amateur movie photographer can produce high-quality talking movies. All accessories are listed and prices are given. *Presto Recording Corporation, 242 West 55th Street, New York City.—Gratis.*

ELECTRICITY AND WHEELS is a 32-page illustrated booklet that presents the fundamentals of electricity and magnetism as applied particularly to the modern automobile. The explanations are given in simple language accompanied by interesting and instructive drawings. *Department of Public Relations, General Motors Corporation, Detroit, Michigan.—Gratis.*

LEAD-TIN-ARSENIC WIPING SOLDER is a five-page discussion of solders and their application to wipe joints which are used in the installation of lead-sheathed telephone cable.—*Bell Telephone Laboratories, Inc., 463 West Street, New York City.—Limited free distribution.*

THE STORY OF SUPERFINISH is a 670-page completely illustrated book, bound with hard covers, that tells the story of this new finishing method for moving parts of machinery. Superfinish, briefly stated, is a method of producing machinery bearing surfaces which will give maximum wearing qualities under heavy-load conditions. *Lynn Publishing Company, 5106 Buckingham Avenue, Detroit, Michigan.—$5.00.*

PLEXIGLAS is a 44-page illustrated booklet that covers the principal properties and more important applications of cast Plexiglas sheet and Crystalite molding powder. Both of these materials are crystal-clear plastics that are finding wide use in a broad range of industries. *Rohm & Haas Company, Inc., Washington Square, Philadelphia, Pennsylvania.—Gratis.*

HYGRADE MIRALUME is a 24-page catalog illustrated in two colors showing a complete range of fluorescent lighting units for business and industry. *Hygrade Sylvania Corp., Ipswich, Massachusetts.—Gratis.*

GE PHOTO DATA BOOK is a 110-page booklet, 3 by 5 inches in size, edited by Karl A. Barleben, F.R.P.S. Packed with technical data of all sorts, including film speed values, flash and flood data, filter data, together with various formulas, the book makes a handy reference that fits nicely into the vest pocket. One of the features of the booklet is an article by Mr. Barleben on "Why and How I Use the G-E Exposure Meter." It also contains a personal exposure record and calendars. *General Electric Co., Schenectady, New York—Free to purchasers of General Electric exposure meter, 50 cents to others.*

SKF SPHERICAL ROLLER BEARINGS is a 36-page catalog that describes and illustrates roller bearing applications in mining, steel, paper, oil, railroad, and allied fields. It also presents information on bearing selection, bearing computations, and various types of roller-bearing design. *SKF Industries, Inc., Front Street and Erie Avenue, Philadelphia, Pennsylvania.—Gratis.*

THE RADIO CONTROL INSTRUCTION MANUAL gives complete data on circuits, systems, and equipment for radio control of models, particularly as applied to gasoline-powered model airplanes. *Radio Control Headquarters, Inc., Granby, Connecticut.—10 cents.*

WHO PAYS THE COST OF HIGHWAYS? is an illustrated booklet that briefly answers pertinent questions regarding highway transportation. It gives direct comparisons with costs in rail transportation. *Association of American Railroads, Transportation Building, Washington, D. C.—Gratis.*

STEEL MAKES THE HOME is a 32-page fully illustrated booklet showing various applications of steel in modern home construction. *American Iron and Steel Institute, 350 Fifth Avenue, New York City.—Gratis.*

GIBSILOY ELECTRICAL CONTACTS is a 16-page catalog which describes a complete line of electrical contacts made from ductile powdered metals. Numerous photographs illustrate various contacts and contact assemblies. Technical data are included. Request catalog C-10 on your business letterhead. *Gibson Electric Company, 8362 Frankstown Ave., Pittsburgh (21), Pennsylvania.—Gratis.*

DEVELOCHROME is an 18-page pocket-size booklet specifically concerned with a new toning developer for use by amateur as well as professional photographers. Using this method it is possible to produce, by direct development, prints in practically any color. *Fink-Roselieve Co., Inc., 109 West 64th Street, New York City.—Gratis.*

THE INSTALLATION AND USE OF ATTIC FANS, by W. H. Badgett, is a 46-page booklet that has been prepared for the use of architects, builders, and home owners. Its scope is limited primarily to residential applications. Profusely illustrated with photographs and detailed drawings, and written in non-technical style. Bulletin No. 52. *School of Engineering, Texas Engineering Experiment Station, College Station, Texas.*

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